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REGISTER

OF THE

BALTIMORE POLYTECHNIC INSTITUTE.

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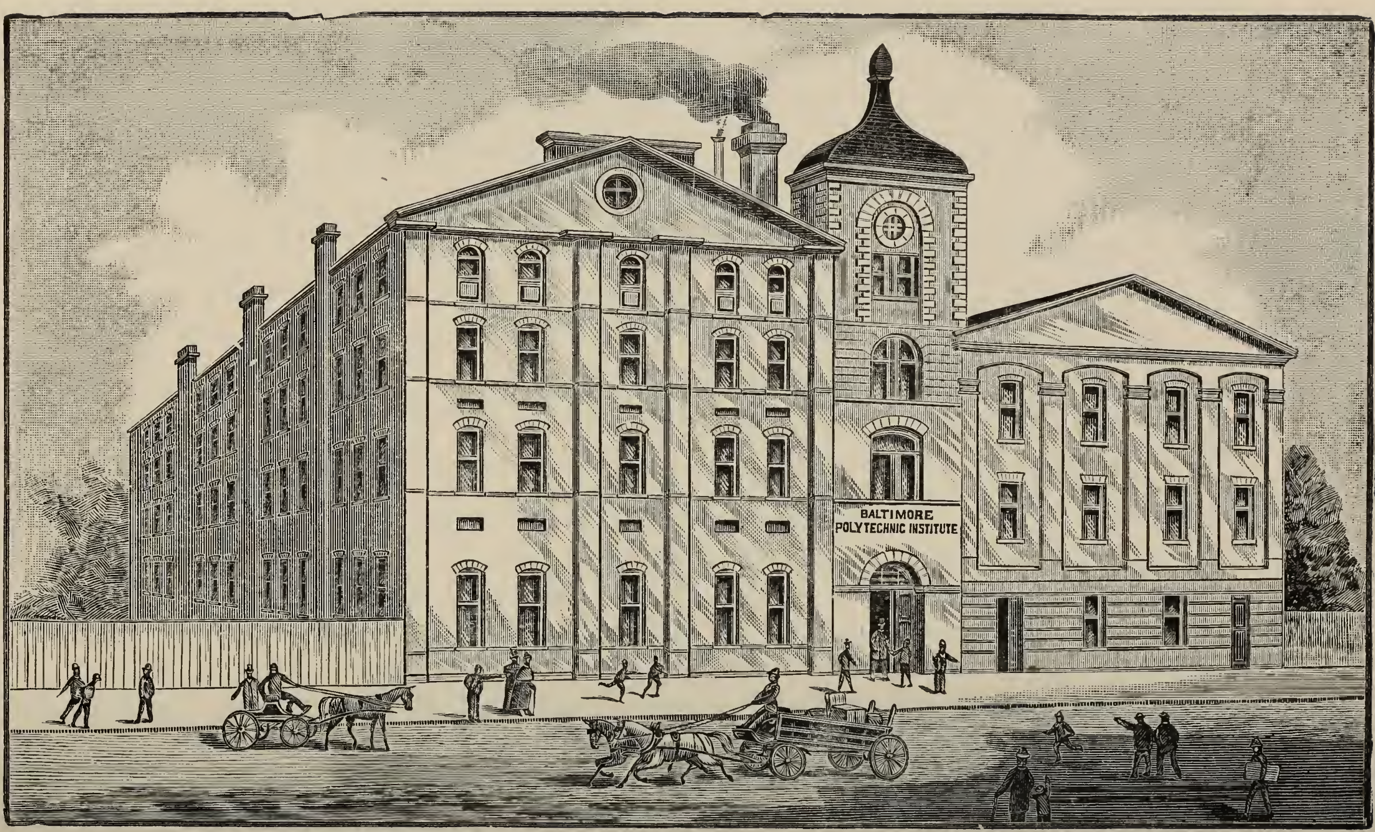

NEW BUILDING. OLD BUILDING.

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ANNUAL REGISTER

OF THE

Baltimore Polytechnic Institute

311-331 COURTLAND STREET

TWENTY-FIRST ACADEMIC YEAR.

1905-1906.

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BALTIMORE, MD.
1906

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BALTIMORE POLYTECHNIC INSTITUTE.

HISTORICAL SKETCH.

The Baltimore Polytechnic Institute, the second manual training school established in the United States as part of a public school system, is one of the several educational institutions of the secondary grade maintained by the city of Baltimore.

Although it is believed that tentative efforts to engraft manual training upon the city's school system were made as early as 1873 or '74, yet the action which led to the establishment of this school was not taken until April, 1883. At a meeting of the Board of Commissioners of Public Schools, held on the 24th of that month, Mr. Joshua Plaskitt, Commissioner for the Ninth Ward, offered a resolution for the appointment of a committee "to consider . . . . the advisability of establishing a school or schools for manual training." The resolution was adopted, and the committee thus appointed recommended the establishment of a school "for manual education." The necessary enabling ordinances and enactments having been passed by the City Council of Baltimore and the General Assembly of Maryland, the school was organized and opened on February 26, 1884, under the name "Baltimore Manual Training School," with Dr. Richard Grady as Director.

In January, 1886, the faculty was reorganized, Lieut. John D. Ford, an officer of the Engineer Corps of the United States Navy, who had been detailed for duty at the school, becoming Principal.

From the opening of the school applicants for admission had been required to pass through the eighth grammar school grade, or to show satisfactory evidence of having had equal instruction; but in September, 1888, it was decided to admit pupils of the 6th, 7th, and 8th grammar grades. This action opened the school to so large a number of young boys that increased accommodations became imperative, and in June, 1890, the new building, devoted to the academic studies and drawing, was finished and occupied.

Lieut. Ford was recalled to the naval service in June, 1890, and was succeeded as Principal by John W. Saville, a retired member of the Engineer Corps of the Navy.

In May, 1893, the name of the school was changed to "Baltimore Polytechnic Institute," and the titles of Principal and Vice-Principal to President and Vice-President, respectively.

Mr. Saville resigned in August, 1899, and was succeeded as President by Lieut. William R. King, Engineer Corps, U. S. N., the present head of the school.

The new charter of Baltimore went into effect on March 1, 1900, and under one of its provisions it devolved upon the Mayor, Hon. Thomas G. Hayes, to appoint, as the head of the Department of Education, a Board of School Commissioners composed of nine persons, to serve without pay, and to be chosen from among those citizens he deemed "most capable of promoting the interests of public education, by reason of their intelligence, character, education, or business qualifications." The names of the distinguished citizens so chosen will be found on page 15.

Another provision of the Charter requires that, "in order to secure the continuance of local interest in, and oversight of the public schools, there shall be appointed by said Board of School Commissioners such number of unpaid School Visitors as may be found requisite." In pursuance of this provision there was appointed as a Board of Visitors to this institution, a group of gentlemen, some of whom are recognized in technical circles throughout the country as being at the head of their respective professions.

The members of the Board of Visitors had no sooner acquainted themselves with the general conditions prevailing in the school—the age and attainments of the pupils of the lower grades, the character of the work done, and the scope of the curriculum—than they submitted to the Board of School Commissioners a very comprehensive and exhaustive report discussing the condition, needs, and aims of the school, and recommending certain changes in the requirements for admission, and in the curriculum. The partial adoption of this report in September, 1900, excluded grammar school pupils from the Institute, thus making the standard for admission the same as that for the City College.

In April, 1901, a further consideration of the report of the Board of Visitors led to the practical addition of one year to the course by permitting graduates to remain for a year of postgraduate work; and in May, 1902, the length of the course was, by action of the Board, set at four years for pupils entering on and after September 15, 1902.

It was further provided that pupils leaving the Institute before the completion of the course should receive certificates of the work done by them up to the time of their withdrawal.

By operation of the new Charter the titles of President and Vice-President were changed, in 1900, to Principal and Vice-Principal.

RECORD OF THE FACULTY AND STAFF.

From the Origin of the Institute to December 31, 1905.

The school was organized on February 26, 1884 under the name "Baltimore Manual Training School"; this name was changed in May, 1893, to "Baltimore Polytechnic Institute."

Richard Grady, M.D., D.D.S., Director, February 26, 1884. Services terminated January 11, 1886.

John D. Ford, P. A. Eng., U. S. N., Instructor in Drawing and Steam Engineering, February 26, 1884. Principal, January 11, 1886. Recalled to Naval Service, June 30, 1890.

William Dugent, Instructor in Wood Work, February 26, 1884. Transferred to Pattern Shop, January 11, 1886, and was in charge of that department until September 17, 1900.

J. H. W. Onion, Instructor in Pattern Department, March 1, 1884. Services terminated June 30, 1886.

A. Newton Ebaugh, First Assistant in Academic Department, January 11, 1886. Vice-President, May 1893. Transferred to Baltimore City College, June 30, 1896, as Professor of History and Political Economy.

C. F. Friese, Instructor in Metal Department, September 1, 1886. Resigned to accept position in Chicago Manual Training School, June 30, 1891.

W. H. Hall. B.C.C., '85, Assistant Instructor in Physics and Chemistry, September 23, 1886. Instructor in Academic Department, June 7, 1898. Head of Department of Physics and Chemistry, September 13, 1899. Head of the Department of Science, June 21, 1901.

William G. Richardson, Assistant Instructor in Machine Department, February, 1887. Instructor in Machine Work and Engineering Materials, September 13, 1899.

Andrew J. Pietsch, Assistant Instructor in Academic Department, September 1, 1887. Transferred to be Principal of Male Grammar School No. 4, September, 1890.

J. C. McSherry, Assistant Instructor in Academic Department, September, 1887. Resigned, April, 1888.

Richard Piez, B.M.T.S., '87, Instructor in Mechanical Drawing, September, 1887. Resigned, September, 1891.

Lawrence Griffith, Assistant to the Principal and Instructor in Freehand Drawing, September, 1887. Resigned, June, 1890.

John L. Yater, Assistant Instructor in Academic Department, September, 1888. Transferred to be Principal of Annex School No. 14, January, 1899.

Flavius J. Pennington, B.M.T.S., '87, Assistant Instructor in Wood Department, September, 1888. Resigned, April 1, 1889.

David G. Butterfield, Assistant Instructor in Academic Department, September 11, 1888. Transferred to be First Assistant in Male Grammar School No. 20, March 19, 1889.

Thomas G. Ford, B.M.T.S., '88, Assistant Instructor in Wood Department, October, 1888. Assistant Instructor in Carving and Pattern-making, September, 1897. Instructor in Pattern-making and Wood-turning, September 17, 1900, and, in addition, Assistant in Mechanical Drawing, September, 1902. Instructor in Carpentry and Pattern making, September, 1903.

John T. Robinson, Assistant Instructor in Sheet Metal Department, October, 1888. Resigned to become instructor in Sheet Metal Work at the Brooklyn Polytechnic Institute, Brooklyn, N. Y., June 30, 1894.

J. Ward Willson, M.D., B.C.C., '61, Assistant Instructor in Academic Department, March 21, 1888. Instructor in Academic Department, September, 1898. Instructor in History, Physiology, and German, September 16, 1901. Instructor in German, English and Science, September, 1902.

George M. Gaither, B.M.T.S., '88, Assistant Instructor in Wood Department, April 1, 1889. Instructor in Carpentry and Carving, September 17, 1900.

Richard H. Uhrbrock, B.C.C., '86; Ph.B., I.W.U., '97, Assistant Instructor in Academic Department, May 15, 1889. Vice-President and Instructor in Mathematics, September, 1896. Head of Department of Mathematics, September 13, 1899. Vice-Principal, June 21, 1901. Acting Vice-Principal, September, 1904.

John W. Saville, P. A. Eng., U. S. N. (retired), Principal and Instructor in Steam Engineering, September, 1890. President and Instructor in Steam Engineering, May, 1893. Resigned, August 31, 1899.

Edward S. Kines, B.C.C., '90, Assistant Instructor in Academic Department, September, 1890. Resigned, October 1, 1894.

J. Henry Laessig, Assistant to Principal and Instructor in Mechanical Drawing, September, 1890. Resigned, June 30, 1893.

Eason Lewis, Lieut., U. S. A., Instructor in Military Drill and Assistant Instructor in Academic Department, November, 1890. Recalled to U. S. Army, April, 1891.

Albert McClean, Instructor in Forge Work, September, 1891. Resigned, January, 1898.

Warren S. Seipp, B.M.T.S., '91, Instructor in Free-hand Drawing, September, 1891. Instructor in Free-hand Drawing and Carpentry, November, 1901. Instructor, Manual Training Centre No. 1, June, 1902. Instructor in Drawing, Carpentry and Sheet Metal Work, September, 1903. Instructor in Drawing, September, 1904.

B. Wheeler Sweany, Instructor in Mechanical Drawing, September, 1892. Transferred to Baltimore City College as Professor of Drawing, October 1, 1897.

Joseph F. McBee, Assistant Instructor in Academic Department, September, 1893. Transferred to be Principal of Annex School No. 14, June, 1894. Re-transferred to the Baltimore Polytechnic Institute as Assistant Instructor in Academic Department, January, 1899. Dismissed, May, 1899.

Nathaniel D. D. Sollers, Assistant Instructor in Academic Department, September, 1893. Resigned, June, 1894.

F. D. J. Kaessmann, Assistant Instructor in Academic Department, September, 1893, until September, 1901.

William A. Jones, Assistant Instructor in Sheet Metal Department, September, 1894. Instructor in Sheet Metal Department, September, 1898. Instructor in Forge and Sheet Metal Work, September 17, 1900.

Samuel M. North, B.C.C., '87, Assistant Instructor in Academic Department, September, 1894. Instructor in Academic Department, September, 1898. Head of Department of English, September 13, 1899. Head of Department of English, including History and Language, June 21, 1901.

Joseph C. O'Conor, Assistant Instructor in Carpentry, September, 1894. Resigned, June 30, 1897.

Henry Sanders, Instructor in Sheet Metal Department, September, 1894. Resigned, November 30, 1894.

William S. Blake, B.C.C., '94, Assistant Instructor in Academic Department, October 1, 1894. Transferred to Male Grammar School No. 1, January, 1899.

Ralph L. Williams, B.P.I., '93, Assistant Instructor in Academic Department, October 1, 1894. Lost at sea, July 4, 1898.

Frederick W. Wild, Instructor in Sheet Metal Department from December 1, 1894, to September 17, 1900.

B. Harrison Branch, B.M.T.S., '92, Assistant Instructor in Academic Department and Assistant in Machine Department, October, 1896. Resigned, April, 1898.

Samuel P. Platt, Instructor in Mechanical Drawing and Descriptive Geometry, October 1, 1897.

J. C. Mattoon, B.M.T.S., '90, Assistant Instructor in Academic Department, November 1, 1897. Resigned, February, 1898.

Oliver Bacharach, B.C.C., '97, Assistant Instructor in Academic Department, April, 1898. Assistant Instructor in Mathematics, September 16, 1901.

William P. Gundry, B.M.T.S., '90, Assistant Instructor in Academic Department, April, 1898. Resigned, December 31, 1901.

J. Edward Broadbelt, B.M.T.S., '90, Ph.G., Maryland College Pharmacy, 1903, Assistant Instructor in Academic Department, September, 1898. Secretary and Assistant Instructor in Science, September 16, 1901.

Harry R. Ruse, B.P.I., '98, Assistant Instructor in Academic Department from January, 1899, to September 17, 1900.

John H. DeValin, Instructor in Forge Work from September, 1898, to September 17, 1900.

William R. King, Passed Assistant Engineer, U. S. N. (retired), U. S. N. A., '75, President and Instructor in Engineering and Applied Mechanics, September 1, 1899. Principal and Head of Department of Engineering, June 12, 1901.

John H. Bramble, B.C.C., '96, Assistant Instructor in Academic Department, October, 1899. Assistant Instructor in Mathematics and Science, September 16, 1901. Assistant Instructor in Mathematics, September 15, 1902.

John Montgomery Gambrill, B.P.I., '97, Instructor in History, Civics, and Literature, June 11, 1902. Resigned to become Assistant State Superintendent of Education in Maryland, July, 1904.

Charles Ernest Conway, B.P.I., '02, Assistant in Department of Engineering and Applied Mechanics, June 11, 1902. At Lehigh University, 1903-1904. Assistant in the Department of Engineering and Applied Mechanics, 1904-1905. Resigned, September, 1905.

George P. VonEiff, B.P.I., '02, Assistant in Department of Science, September, 1903. Resigned, June, 1904.

William L. DeBaufre, B.P.I., '03, Assistant in Departments of Engineering and Mathematics, September, 1903. At Lehigh University, 1904-1905. Assistant in Department of Engineering, 1905-1906.

Irving L. Twilley, A.M., Washington College, '92, Instructor in Department of English, September, 1903. Transferred to the Department of Science as Instructor in Physics and Physical Geography, June, 1904.

Henry A. Converse, A.B., Hampden-Sidney College, 1893; Ph.D., Johns Hopkins University, 1903; Instructor in Mathematics, May, 1904.

Edward Reisler, A.M., Western Maryland College, '88, Instructor in History, Civics, and Composition, May, 1904.

Elmer M. Harn, A.B., Rock Hill College, 1892; A.M., Rock Hill College, 1895. Instructor in History, Literature, and Composition, July, 1904. Instructor in Literature and Composition, September, 1905.

Isaac L. Otis, A.B., New York University, 1899, Instructor in Literature and Composition, September, 1904. Instructor in Composition and History, September, 1905.

Harry M. Mason, B.P.I., '04, Assistant in Department of Science, September, 1904. Resigned, June, 1905.

Allen L. Malone, B.P.I., '02; at Cornell University, 1902-1903 and 1903-1904. Instructor in Engineering Materials and Forge Work, October 1, 1904.

Rowland Watts, A.B., Washington College, 1886; A.M., Washington College, 1888. Instructor in Physics and Physical Geography, September, 1905.

Charles C. Grove, A.B., Pennsylvania College, 1900; A.M., Pennsylvania College, 1903. Instructor in Mathematics, September, 1905.

Edwin L. Willson, B.P.I., '05, Assistant in Department of Science, September, 1905.

Allan B. Souther, B.S., Harvard, '97, Instructor in Mechanical Drawing and Machine Work, October, 1905.

John W. Dorsey, B.P.I., '05, Assistant in Department of Engineering, September, 1905. At Lehigh University, 1905-1906.

BOARD OF SCHOOL COMMISSIONERS.

JOSEPH PACKARD, *President,*
ALCAEUS HOOPER,
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JAMES H. PHILLIPS,
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MENDES COHEN.

SUPERINTENDENT OF PUBLIC INSTRUCTION,

JAMES H. VAN SICKLE.

CALENDAR FOR SCHOOL YEAR 1905-1906.

September 13, Wednesday	Opening of Session.
November 24, Friday	First Quarter ends.
November 27, Monday	Second Quarter begins.
November 30, Thursday	Thanksgiving Day.
December 22, Friday	Christmas Vacation begins.
January 3, Wednesday	Christmas Vacation ends.
February 5, Monday	Semi-Annual Examinations begin.
February 16, Friday	Second Quarter ends.
February 19, Monday	Third Quarter begins.
February 22, Thursday	Washington's Birthday.
March 30, Friday	Third Quarter ends.
April 2, Monday	Fourth Quarter begins.
April ———	Arbor Day.
April 12, Thursday	Easter Vacation begins.
April 16, Monday	Easter Vacation ends.
May 14, Monday	Annual Examinations begin.
May 30, Wednesday	Decoration Day.
June 12, Tuesday	Commencement Day.
September 13, Thursday	Opening of Session.
November 23, Friday	First Quarter ends.
November 29, Thursday	Thanksgiving Day.
November 26, Monday	Second Quarter begins.
December 21, Friday	Christmas Vacation begins.

FACULTY.

WILLIAM R. KING, U. S. N., *Principal*
and
Head of Department of Engineering.

RICHARD H. UHRBROCK, Ph.B., *Acting Vice-Principal*
and
Head of Department of Mathematics.

WILLIAM H. HALL,
Head of Department of Science.

SAMUEL M. NORTH,
Head of Department of English, including History and Language.

STAFF.

JOHN WARD WILSON, M. D.,
German, and Civics.

SAMUEL P. PLATT,
Mechanical Drawing and Descriptive Geometry.

OLIVER BACHARACH,
Mathematics.

JOHN H. BRAMBLE,
Mathematics.

JOHN EDWARD BROADBELT, Ph.G.,
Secretary, and Science.

WARREN S. SEIPP,
Drawing.

IRVING L. TWILLEY, A. M.,
Science.

HENRY A. CONVERSE, Ph.D.,
Mathematics.

EDWARD REISLER, A.M.,
Civics, History, and Composition.

ELMER M. HARN, A.M.,
Composition and Literature.

ISAAC L. OTIS, A.B.,
Composition and History.

ROWLAND WATTS, A.M.,
Science.

CHARLES C. GROVE, A.M.,
Mathematics.

WILLIAM L. DEBAUFRE,
Engineering.

ALLAN B. SOUTHER, B.S.,
Drawing and Machine Work.

EDWIN L. WILLSON,
Graduate Assistant in Science.

MECHANICAL DEPARTMENT.

WILLIAM G. RICHARDSON,
Machine Work and Engineering Materials.

THOMAS G. FORD,
Pattern-Making and Wood-Turning.

WILLIAM A. JONES,
Sheet Metal Work.

GEORGE M. GAITHER,
Carpentry and Wood-Carving.

ALLEN L. MALONE,
Engineering Materials and Forge Work.

COURSE OF STUDY AND GENERAL STATEMENT OF PLAN AND PURPOSE.

The course of study for the Baltimore Polytechnic Institute is designed to accomplish the following purposes:

1. To give a sound fundamental education to pupils whose inclinations and other circumstances preclude a college course.

2. To give to youth that healthful and highly valuable manual training which broadens education, and conduces to dexterity, contrivance, and invention.

To this end the time usually devoted to Greek and Latin is employed, during two years of the course, in carpentry, sheet-metal, and light forge exercise. These exercises cover what is known as Manual Training, and are given with special reference to their educational value.

3. To give to students in the third and fourth years such studies in Mathematics, Physics, and Chemistry, and such mechanical exercises in Applied Manual Training as will fit them:

(*a*) For immediate and remunerative employment in the drafting-room, or for engagements in the wide field of electrical and mechanical engineering, where, it is believed, their training will lead to rapid advancement.

(*b*) For entrance to advanced standing into an institution of technology, should a higher technical education be desired.

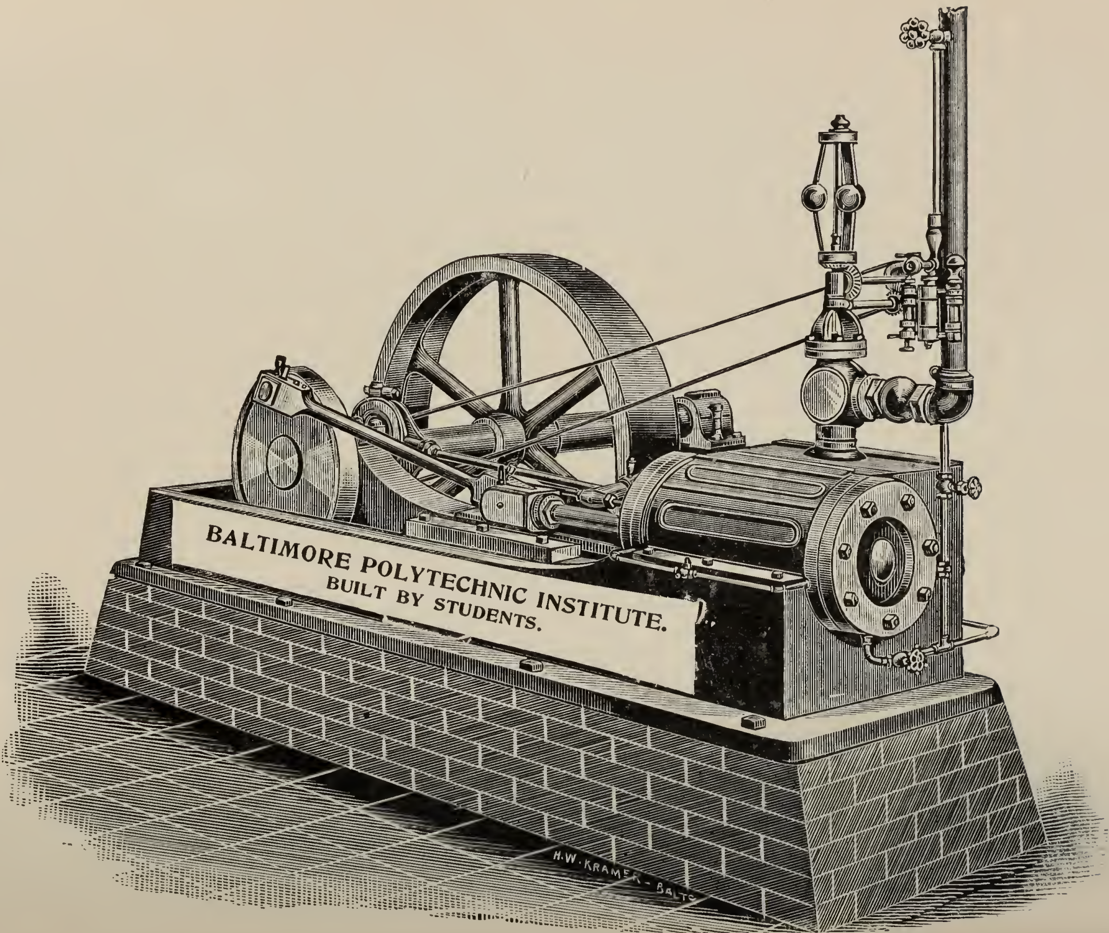
For the attainment of these objects there is one carefully planned general course of study, no effort being made to specialize until the fourth year, by which time a student will have acquired a considerable degree of practical skill and intimate knowledge in some one of the professions based on mechanical art and applied science that he may have elected to follow. Thus, for example, the student who may, toward the end of the course, elect to follow electrical engineering as a profession, will be afforded special opportunities for laboratory practice in the manipulation of currents, methods of testing, etc. The student who elects to follow mechanical or steam engineering as a life work, studies the elements of the theory of construction and operation of machines, special attention being given to the theory of the steam engine. In the drawing-room he is given elementary work in engine and machine design, and in the shops he does some actual work in engine and machine building.

No attempt is made to teach trades, but the equipment is of such a nature that the instruction given in the shops is designed to be correlative to the work of the class-room, and results are aimed at that will insure success in mechanical pursuits subsequent to graduation. It is believed that instruction in correct methods of using tools, and practical illustrations of how, and for what purpose, things are done, are of more value than mere excellence in hand skill.

Instruction in the English Department is given during the first, second, and third years, and embraces Composition, Rhetoric, Literature, History, and Civics. Special effort is made to inculcate sound principles in the choice of words and in phraseology, and frequent written exercises in the various kinds of composition are required of the student. The first year work in History is followed in the second year by a course in Civics, which is designed to ground the student in the fundamental principles of government and to emphasize their application to American citizenship.

The instruction in German during the second and third years, and in French during the fourth year, is designed to give a reading, rather than a speaking knowledge of these languages, in order to meet entrance requirements of institutes of technology.

In Mathematics, care is taken at the beginning of first year to discover and correct any defects in fundamental training, after which the course of instruction proceeds in Algebra,


BALTIMORE POLYTECHNIC INSTITUTE.
BUILT BY STUDENTS.
H.W. KRAMER - BALTO

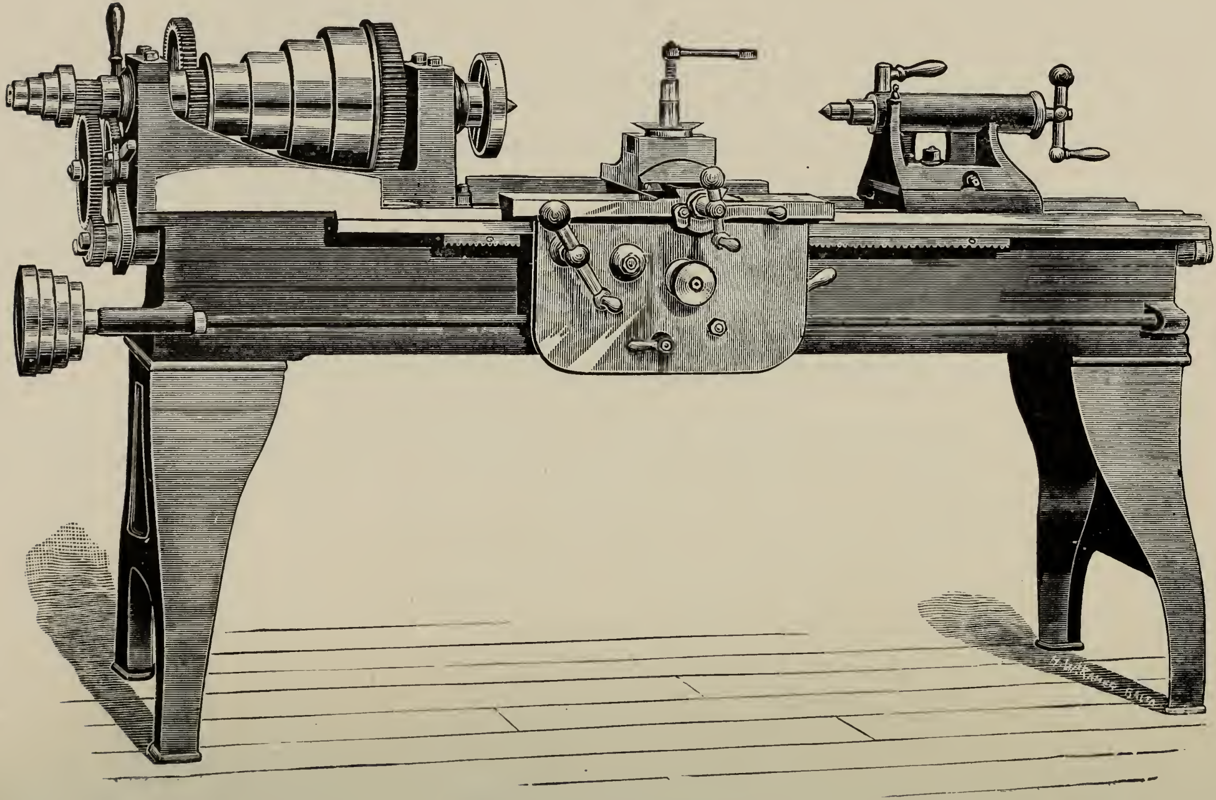
Geometry, Trigonometry, and Analytical and Descriptive Geometry. During the fourth year the instruction given in the Engineering Department in Dynamics and Thermodynamics involves in its very elements the use of equations and mathematical principles which can be understood only by resort to the Calculus. For this reason instruction in the Differential and Integral Calculus is indispensable. The course is sufficiently broad to fit students for more advanced work, and includes the fundamentals of differentiation and integration, the development of the theorems of Taylor and Maclaurin, and applications of the subject to questions of maxima and minima, areas, volumes, and moments of inertia. Without such instruction, a student at graduation will be unable to read understandingly a treatise of any of the mechanical sciences.

In Physics, the work of the first and second years embraces the properties of matter and elementary mechanics, the instruction being accompanied with lectures illustrated by experiments, and with practical work in the laboratory. The instruction of third and fourth year students in this subject is confined to Heat and Electricity. The dynamic theory of heat, the conversion of heat into mechanical work, and the thermodynamics of the stean engine are the particular features of the fourth year in the study of Heat.

In Electricity, the work of the fourth year consists of practical applications of the theoretical study of the second and third years, and of commercial electricity. Electric lighting, both arc and incandescent, is discussed from constructive and economic standpoints, especially high and low voltage distribution. The dynamo and motor are treated in detail—operating, designing, and winding being carefully considered. The experimental equipment for this work consists of a twenty-five kilowatt generator, built by the students; a one-half horse power alternating current motor coupled to a twenty-five volt multipolar generator; and several smaller machines of various types. These appliances, with the electric light equipment of the Institute, present opportunities for personal observations and operation of electrical machinery and the various defects and faults to be overcome. Alternating currents are treated both mathematically and experimentally, and converters, motors, impedance coils, and measuring instruments are used by students for verifying laws and descriptions given in lectures. The switchboard and the generating plant afford opportunities for power-station practice, and the electric railway is treated in a practical manner. The newest and best methods of telegraph and telephone construction are presented, the telephones of the Institute being installed on the central-energy plan. Special features of the course are the various tests for insulation resistance of conductors, the tests for grounds, faults, and short circuits on lines, and the treatment of the defects in the dynamo and motor, and remedies therefor.

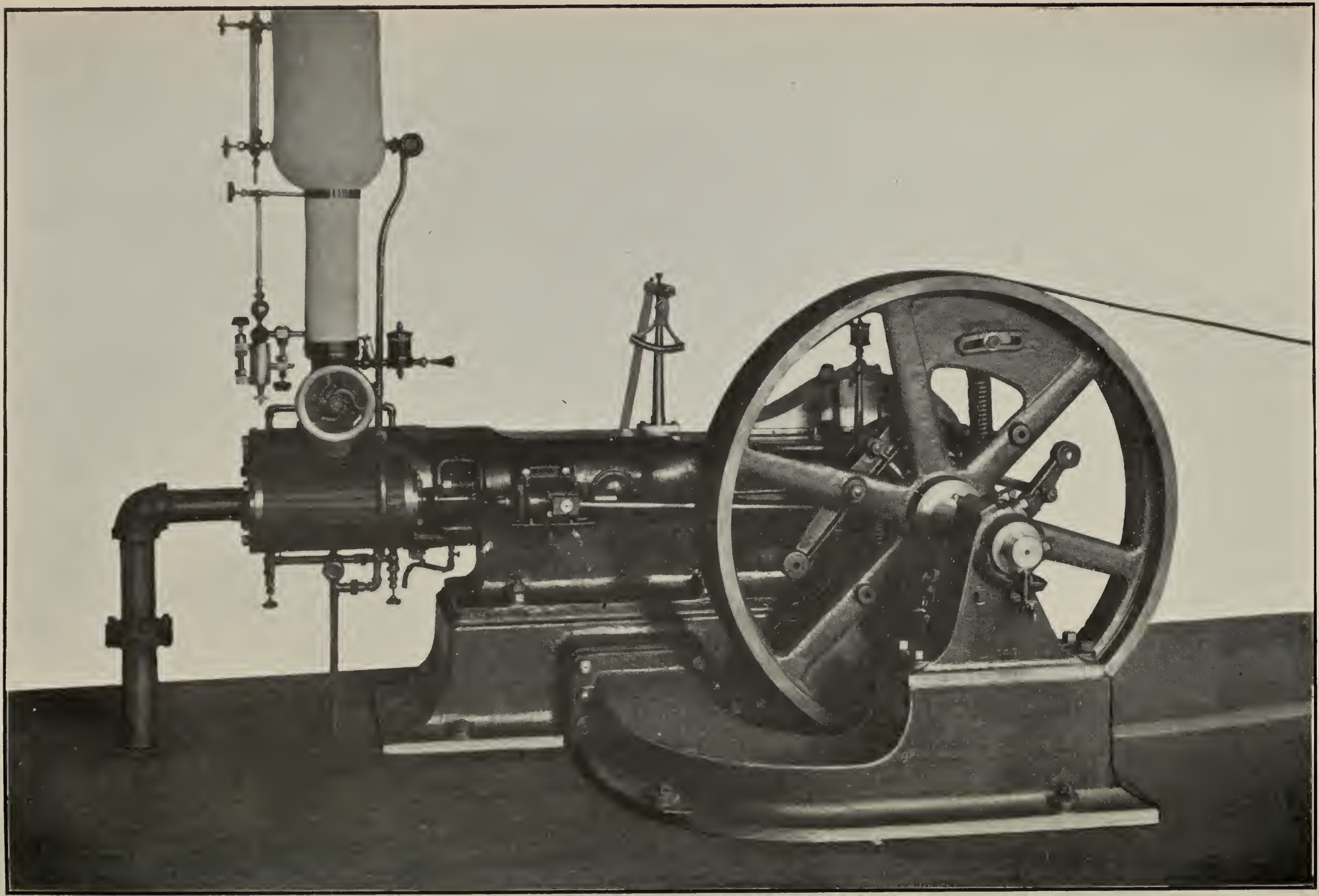
For the study of Chemistry there are chemicals and apparatus in the laboratory to give to the third year students instruction concerning the nature and reactions of the chemical elements and their compounds, and to students of the fourth year a brief course in qualitative and quantitative analysis, the compounds formed in the various reactions and their chemical equations being particularly emphasized.

In the Department of Engineering, the instruction given the fourth year students in theoretical and applied mechanics, which extends well into the Sophomore year of an institute of technology, embraces the laws of equilibrium and motion; centre of gravity; friction; principles of work; moments of inertia; mechanics of materials; and an elementary study of the stresses and deformations produced in standard specimens of metals when subjected to tension, compression, and shearing. The work of the third and fourth year students in steam engineering consists of the study of thermodynamics of the steam engine in as comprehensive a manner as the facilities of the Institute and the maturity of the students permit. Numerous calculations are made involving engine and boiler efficiencies and proportions, and the study of the indicator is supplemented with practice in taking diagrams, from which the consumption



BUILT BY STUDENTS.

and distribution of the steam, and the power of the engine, are determined. The advantages and disadvantages of the different kinds of steam boilers are studied, particular attention being given to such attachments as separators, feedwater heaters, and mechanical stokers. The plant for this work consists of an inverted triple expansion engine of 100 I. H. P., an inverted compound engine of 60 I. H. P., a high speed automatic cut-off engine (Harrisburg standard) of 46 I. H. P., a horizontal power engine of 25 I. H. P., a Campbell & Zell sectional boiler (rated at 100 horse-power), and a Roberts safety water tube boiler, capable of generating steam for the production of 120 I. H. P. when used in connection with the triple expansion engine. The engines mentioned above were built by the students, the first two after designs of the Bureau of Steam Engineering of the Navy Department. Grouped in the mechanical laboratory are all the engines, the 25 K. W. generator, the switchboard controlling the lighting installation of the Institute, and a Riehle testing machine of 50,000 pounds capacity. The compound and triple expansion engines may be worked singly or together in connection with a friction dynamometer especially designed at the Institute, an internal circulation of water in the brake wheel enabling the engines to run continuously in making power tests. The Roberts boiler is installed in a room immediately connected with the laboratory, and furnishes steam at 150 pounds pressure per square inch for the stage expansion engines, and at 95 pounds and 40 pounds to the high speed and power engines, respectively, Foster regulators reducing the pressure as desired. Horizontal and vertical separators are placed in the steam pipes to insure the delivery of dry steam to the engines, and connections are made for calorimeter tests. The surface condenser used in connection with the stage expansion engines may also be connected with the exhaust of the high-speed engine when desired. The water from condensation is delivered to a filter of approved design by a Knowles independent air pump, and thence direct to the boiler, either by a Dean pump or Penberthy injector. For purposes



HIGH SPEED AUTOMATIC CUT-OFF ENGINE (HARRISBURG STANDARD).

of economy tests of the engines and boiler, the feed water is made to pass through weighing tanks of galvanized iron.

In the mechanical drawing-room are ninety-five tables of approved design, and an equipment of instruments and models well adapted to the requirements of an advanced course in the subject. Third-year students are required to make a free-hand sketch of the parts of some machine, from which a finished drawing, tracing, and blue print are made. The work of the fourth-year students in machine design tends to make them draftsmen in the true sense—not mere copyists.

The material equipment in the machine, pattern, forge, sheet metal, and carpentry shops is equal, and in some respects superior, to that of any similar institution in the country.

THE COURSE OF INSTRUCTION IN DETAIL.

Note.—Students completing the course as here outlined obtain full Sophomore standing with some Sophomore credits in the courses leading to the degrees of M.E., E.E., and C.E. at Cornell and Lehigh universities.

DEPARTMENT OF ENGINEERING AND APPLIED MECHANICS.

FIRST YEAR COURSE—D CLASS.

Lectures and Practical Exercises.

(*a*) *Carpentry.*—16 weeks, 6 periods a week.

(*b*) *Sheet Metal.*—16 weeks, 6 periods a week.

Soldering; sheet metals; Venetian iron and repousse work.

(*c*) *Mechanical Drawing.*—32 weeks, 4 periods a week.

Use of instruments; lettering; elementary lessons.

SECOND YEAR COURSE—C CLASS.

Lectures and Practical Exercises.

(*a*) *Review of Carpentry.*—4 weeks, 6 periods a week.

(*b*) *Introductory Vise Work.*—8 weeks, 6 periods a week.

(*c*) *Forge.*—8 weeks, 6 periods a week.

Light forging and welding.

(*d*) *Pattern.*—12 weeks, 6 periods a week.

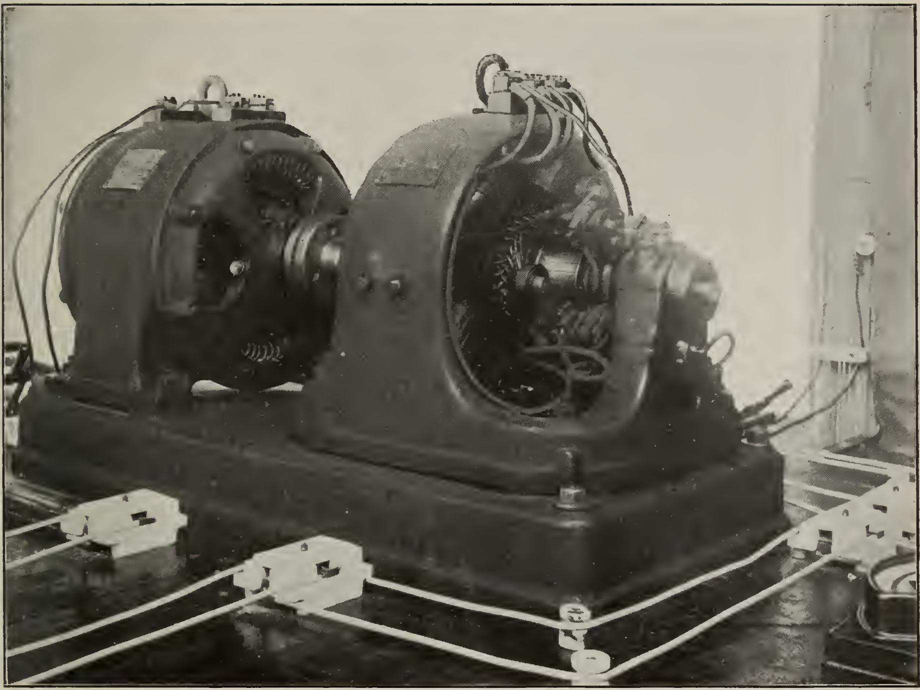
(*e*) *Mechanical Drawing.*—32 weeks, 5 periods a week.

Hatching; tinting; neatness and accuracy; scale drawing. Intersection of surfaces and development of sheets.

THIRD YEAR COURSE—B CLASS.

Steam and the Steam Engine.—32 weeks, 4 periods a week.

Early history and progress of steam engineering; operation of steam machinery and nomenclature of the constructive details; temperature and heat; combustion of fuel and steam generation; efficiency.



WESTINGHOUSE MOTOR-GENERATOR.

USED IN LABORATORY.

Mechanical Drawing.—32 weeks, 4 periods a week.

Detail drawings of machines from free-hand sketches; the working drawing, tracing and blue print. Descriptive Geometry (see course in Mathematics).

Practice.—(*a*) Pattern Shop; 16 weeks, 6 periods a week.

Exercises in making patterns for wrenches, pulleys, eccentrics, pillow-blocks, gears, globe valves, pipe joints, and core boxes where necessary.

Lectures on construction and finish of patterns; green sand molding, open sand molding, loam molding, mixing of iron and of brass, and on the operation of the cupola.

(*b*) Machine Shop, Forge Shop, and Laboratory; 16 weeks, 6 periods a week.

Work on the lathe, planer, milling machine, drill-press, and vise. Forging and tempering machine cutting tools; casehardening; chasing. Operating engines and taking indicator diagrams.

FOURTH YEAR COURSE—A CLASS.

Steam and the Steam Engine.—32 weeks, 3 periods a week.

The slide valve; the indicator and measurement of power; indicator diagrams—theoretical and actual; stage expansion engines; expansion of gases, with particular reference to different conditions of steam expansion; the ideal and actual engine; engine and boiler design; engine and boiler testing; mechanical draft; heating and ventilation.

Mechanics.—32 weeks, 4 periods a week.

First Principles.—Matter; mass; inertia; velocity; acceleration, force; absolute measure of force; gravity; gravitation units of measure; comparison of gravitation and absolute measure of force.

Kinematics.—Motion in a straight line with a constant acceleration; falling bodies; resolution and composition of velocities; the conversion of motion; harmonic motion; velocity ratios.

Dynamics.—(*a*) Statics.—The parallelogram, triangle, and polygon of forces; composition and resolution of forces; conditions of equilibrium; transmissibility of force; parallel forces; moments of forces and of couples; conditions of equilibrium of a body under the action of three forces in one plane; centre of gravity; friction; virtual velocities; the mechanical powers. (*b*) Kinetics.—The laws of motion; centripetal and centrifugal forces; kinetic energy, or vis viva, of a moving body; work.

Mechanics of Materials.—Stress; strain; elastic limit; ultimate strength; bending and resisting moments; moment of inertia; radius of gyration; simple and cantilever beams; struts; deflection; torsion; resilience; bending-moment and shear diagrams.

Graphic Statics.—The funicular polygon; the reciprocal diagram for determining stresses in framed structures.

Mechanics of Machinery.—Transmission of power by means of belts and toothed-gears; theory and action of pumps. Kinematics.—Velocity diagrams, toothed-gears, couplings, belt gearing, cams, parallel and straight-line motions.

Design and Mechanical Drawing.—32 weeks, 4 periods a week.

Design.—Proportioning of machine parts, such as spur, bevel, and worm gearing, belt pulleys, and bearings, from empirical and rational formulas. The application of the mechanics of materials to the design of some part of an engine or of a tool, such as cylinder, connecting rod, valve, screw jack. The Zeuner Diagram.

Mechanical Drawing.—The drafting accompanying the work in design; free-hand sketches, working drawings, tracings, and blue prints.

Practice.—32 weeks, 2 periods a week.

Actual running and indicating of steam engines; valve setting; testing for tension, compression, and flexure with a Riehle machine; machine work involving accuracy and finish; economy tests of engines and boilers; calorimeter tests for quality of steam.

DEPARTMENT OF MATHEMATICS.

FIRST YEAR COURSE—D CLASS.

Explanation and Demonstration.—32 weeks, 2 periods a week.

The most difficult and important features of the course are explained and demonstrated by the instructors.

Algebra.—32 weeks, 4 periods a week.

Fundamental operations; integral equations; factors and multiples; fractions; simultaneous linear equations; inequalities; indeterminate linear equations; involution; evolution; surds; imaginary and complex numbers; doctrine of exponents; the reduction and solution of quadratic equations; ratio and proportion; arithmetical, geometrical, and harmonical progressions; permutations, combinations; binomial theorem.

Geometry.—32 weeks, 3 periods a week.

Geometry of the straight line and circle; proportion; properties of similar figures; original exercises.

SECOND YEAR COURSE—C CLASS.

Geometry.—16 weeks, 4 periods a week, and 16 weeks, 3 periods a week.

Areas of polygons; regular polygons; circles; lines and planes in space; polyhedrons; cylinder; cone; sphere; original exercises.

Advanced Algebra.—16 weeks, 2 periods a week.

Comprehensive review of the work of the preceding year from surds; partial fractions; binomial theorem; logarithmic usage; exponential and logarithmic series.

Plane Trigonometry.—16 weeks, 3 periods a week.

Functions of the acute angle; the right triangle; use of tables; goniometry.

THIRD YEAR COURSE—B CLASS.

Plane Trigonometry.—10 weeks, 3 periods a week.

The oblique triangle; miscellaneous examples.

Spherical Trigonometry.—12 weeks, 3 periods a week.

The right spherical triangle; the oblique triangle; applications of spherical trigonometry.

Surveying.—10 weeks, 3 periods a week.

Instruments and their uses; land surveying.

Analytic Geometry.—32 weeks, 4 periods a week.

The straight line; circle; parabola; ellipse; hyperbola; transformation of co-ordinates; construction of loci; higher plane curves.

Descriptive Geometry.—Time taken from mechanical drawing, as the subject is taught in conjunction with that subject.

Projections; problems in straight line and plane; projections and sections of solids; curved surfaces and tangent planes; development and projection of screw threads; intersection of surfaces.

FOURTH YEAR COURSE—A CLASS.

Differential and Integral Calculus.—32 weeks, 5 periods a week.

Differentiation of algebraic and of transcendental functions; successive differentiation; expansion of functions, including the development of Maclaurin's and of Taylor's theorems; evaluation of indeterminate forms; mode of variation of functions of one variable, including geometric problems in maxima and minima; differentiation of functions of more than one variable; tangents and normals; derivatives of arcs, areas, volumes, and surfaces of revolution; circle of curvature; radius of curvature; fundamental rules and methods of integration; geometrical applications of the calculus to lengths of curves, to areas, to volumes of solids of revolution; integration of trigonometric functions; successive integration; applications to mechanics.

DEPARTMENT OF PHYSICS AND CHEMISTRY.

FIRST YEAR COURSE—D CLASS.

General Physics.—32 weeks, 2 periods a week.

Properties of matter; C. G. S. units; falling bodies; work and power; elementary mechanics; specific gravity; elements of hydromechanics; pressure and expansion of air; lectures illustrated by experiments.

Physical Geography.—32 weeks, 2 periods a week.

The subject is taught by lectures, demonstrations, and recitations, the relation between physiographic conditions and commercial and agricultural products being emphasized.

SECOND YEAR COURSE—C CLASS.

General Physics.—32 weeks, 4 periods a week.

Sound.—Nature, intensity, and propagation; sound waves, pitch; quality; reinforcement.

Heat.—Thermometers; calorimetry; coefficients of expansion; boiling points; distillation; latent heat; laws of thermodynamics; mechanical equivalent of heat.

Light.—Nature, sources, and propagation; reflection; refraction; dispersion; polarization; interference; lenses; optical instruments.

Electricity.—Magnetism; currents; induction; static electricity; general study of the applications of electricity.

Problems and practical work in laboratory.

SECOND YEAR COURSE—C CLASS.

Heat.—32 weeks, 2 periods a week.

Thermometers; calorimetry; coefficients of expansion; boiling points; distillation; latent heat; laws of thermodynamics; mechanical equivalent of heat. Practical work in laboratory.

Electricity.—32 weeks, 2 periods a week.

Magnetism; currents; induction; static electricity; lectures and experiments.

THIRD YEAR COURSE—B CLASS.

Electricity.—32 weeks; 3 periods a week.

Deduction of formulæ; use of galvanometers; magnet testing; laws of induction; simple alternating currents; relation of electricity to work and power; practical work in laboratory.

Chemistry.—32 weeks, 2 periods a week.

Recitations in general chemistry; experiments illustrating text.

FOURTH YEAR COURSE—A CLASS.

Electricity.—32 weeks, 4 periods a week.

Lectures and recitations in applied electricity, including electro-chemical action; principles of the dynamo, motor, and transformer; railways; line and machine testing; telegraph and telephone; electric lighting; practical work in laboratory.

Chemistry.—32 weeks, 4 periods a week.

Theory of analysis; qualitative analysis of solutions containing one base and one acid; qualitative analysis of solution containing several salts; qualitative analysis of powders; quantitative analysis of silver, ammonia, and iron solutions by volumetric method; quantitative analysis of solutions for barium and phosphoric acid by gravimetric method; simple determinations of carbon, sulphur, manganese, and silicon, in iron and steel.

DEPARTMENT OF ENGLISH, INCLUDING HISTORY AND LANGUAGE.

FIRST YEAR COURSE—D CLASS.

Composition and Rhetoric.—32 weeks, 2 periods a week.

Study of text and frequent written exercises in paragraphing and sentence structure, based upon Narration and Description; Letter Writing.

Literature.—32 weeks, 2 periods a week.

(*a*) Leading facts in the lives of representative American writers.

(*b*) Reading and study in class of the following selections: Legend of Sleepy Hollow, Forest Hymn, Evangeline, The Gold-Bug, Snow-Bound, Vision of Sir Launfal, Tales of the White Hills.

History.—32 weeks, 3 periods a week.

The course includes Greek and Roman History, and the subjects are taught both chronologically and topically.

SECOND YEAR COURSE—C CLASS.

Composition and Rhetoric.—32 weeks, 2 periods a week.

Study of text and frequent written exercises upon the Sentence, the Paragraph, and the Whole Composition.

Literature.—32 weeks, 2 periods a week.

(a) Leading facts in the lives of representative English writers since Pope's time.

(*b*) Study in class of the following texts: The Vicar of Wakefield, Ivanhoe, Silas Marner, The Deserted Village, The Lady of the Lake, The Ancient Mariner.

German.—32 weeks, 3 periods a week.

Study of the grammar, and reading.

Civics.—32 weeks, 2 periods a week.

The principles of government and their applications to American citizenship.

THIRD YEAR COURSE—B CLASS.

Literature.—32 weeks, 2 periods a week.

Study of the works prescribed by the Committee on Uniform Entrance Requirements. The texts selected for 1907 are: Julius Caesar, Milton's L'Allegro, Il Penseroso, Comus, and Lycidas; Burke's Conciliation with America; Macaulay's Essay on Addison; Macaulay's Life of Johnson.

Frequent written exercises.

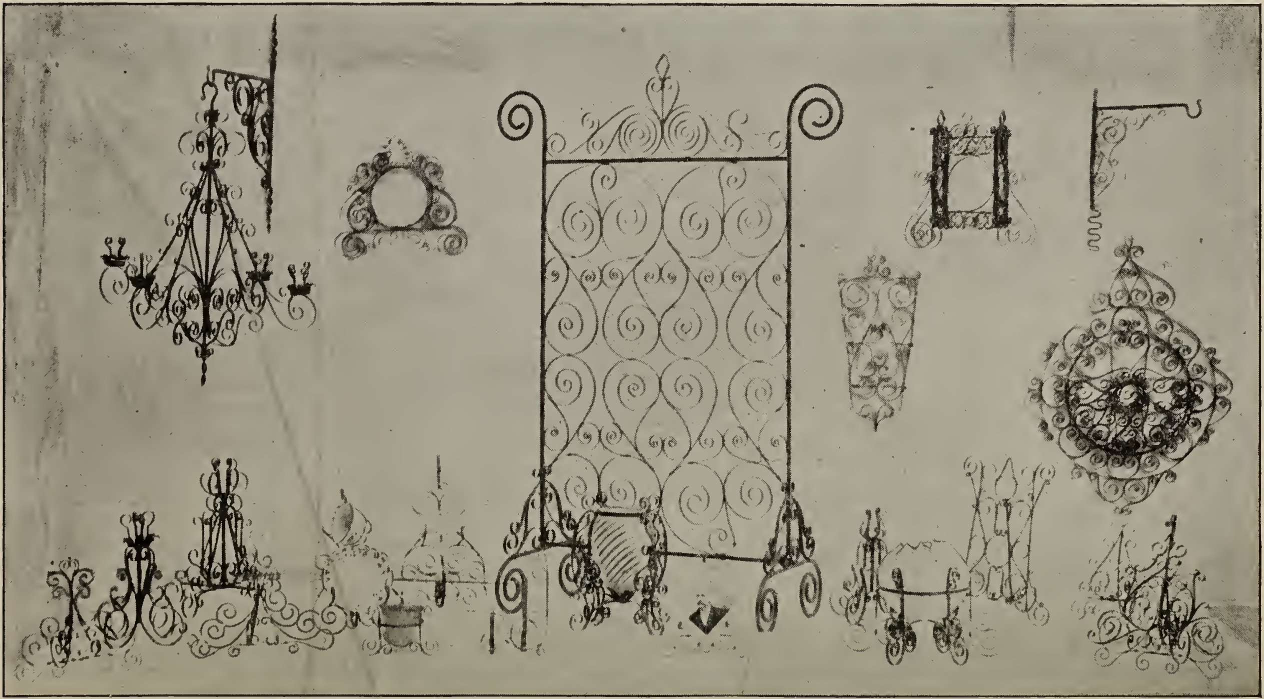
German.—32 weeks, 2 periods a week.

Composition, and reading easy scientific prose.

FOURTH YEAR COURSE—A CLASS.

French.—32 weeks, 4 periods a week.

Study of the grammar, and reading simple science.



VENETIAN IRON WORK.

TIME DEVOTED TO THE DIFFERENT SUBJECTS COMPRISING THE FOUR YEAR COURSE.

	NUMBER OF HOURS PER YEAR.				
	1st Year.	2nd Year.	3rd Year.	4th Year.	Aggregate.
DEPARTMENT OF ENGINEERING.					
Carpentry	96	24			120
Sheet Metal	96				96
Vise		48	32		80
Forge		48	32		80
Pattern		72	96		168
Machine			32	24	56
Mechanical Laboratory				40	40
Mechanical Drawing	128	160	96		384
Descriptive Geometry			32		32
Machine Design				128	128
Steam Engineering			128	96	224
Mechanics				64	64
Mechanics of Materials				64	64
DEPARTMENT OF MATHEMATICS.					
Algebra	160	32			192
Geometry	128	112			240
Geometry, Analytic			128		128
Trigonometry, Plane		48	30		78
Trigonometry, Spherical			36		36
Trigonometry, Surveying			30		30
Calculus, Differential				80	80
Calculus, Integral				80	80
DEPARTMENT OF SCIENCE.					
Physical Geography	64				64
Physics	64	96			160
Physics, Laboratory		32			32
Electricity			64	96	160
Electricity, Laboratory			32	32	64
Chemistry, Elementary			32	*96	128
Chemistry, Laboratory			32	*32	64
Chemistry, Analytic				128	128
DEPARTMENT OF ENGLISH.					
Composition and Rhetoric	64	64			128
Literature	64	64	64		192
History	96				96
Civics		64			64
German		96	64		160
French				128	128
Totals	960	960	960	960	3,840

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* Students preparing for the universities receive instruction in Elementary instead of Analytic Chemistry.

REQUIREMENTS FOR ADMISSION.

Pupils bearing properly attested certificates of having passed the prescribed Grammar School Course of Public School System of Baltimore are entitled to enrollment.

Other applicants residing in the city will be admitted after passing an examination covering the requirements of the eighth grammar school grade. Eighth grade grammar school pupils who failed of promotion are not eligible for admission under this requirement. Specimen entrance examination papers covering the requirements of the eighth grade will be found on pages 69 and 70.

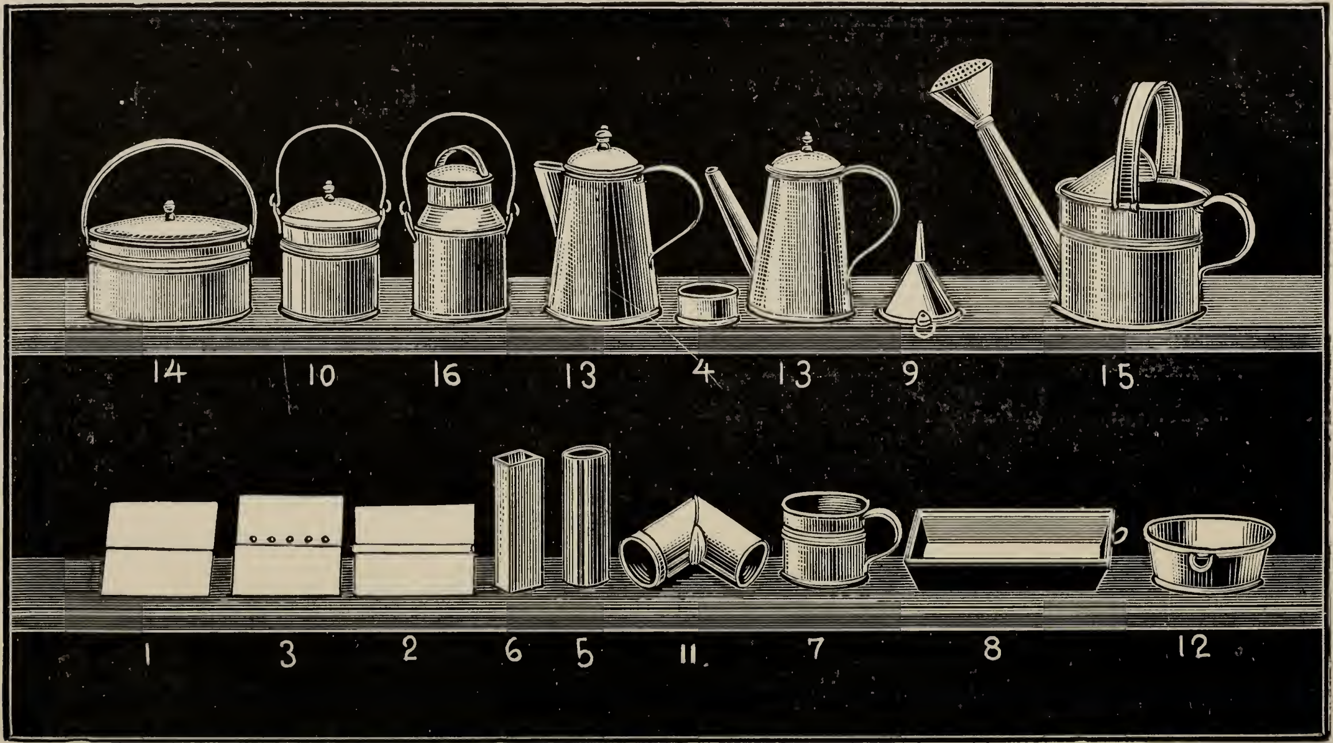
Non-resident applicants, in addition to passing the entrance examination, are required to pay an annual fee of $72.00, charged for tuition and for the use of books.

After having successfully passed the entrance examination, a non-resident applicant must register as such at the office of the Secretary of the Board of School Commissioners, where he will be furnished with a bill for the first quarterly installment of the fee; and a presentation at the Institute of a coupon from the bill, signed by the City Comptroller, will be accepted as evidence of payment, and entitle the applicant to enrollment.

MERIT ROLLS.

Merit rolls, showing the proficiency of students in each branch of study, are made out annually for the different classes.

Each subject is assigned a coefficient indicative of its relative weight; and the final mark of a student in a subject (on a scale of 100) is multiplied by its coefficient. The sum of the products is the final mark of the student for the year. This mark is a certain percentage of the sum of the coefficients, and such percentage is the student's average for the year.



TIN WORK.

BALTIMORE POLYTECHNIC INSTITUTE.

Final Merit Roll and Fourth Year Record of Graduating Class of 1905.

Order of Merit.	Names.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech. Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 4th Year.	Aggregate for 3rd Year.	Aggregate for 2nd Year.	Aggregate for 1st Year.	Aggregate for 4th, 3rd, 2nd, and 1st Years.	Graduating Average.
	Maxima	... .	7	10	10	8	10	10	10	5	5	5	80	60	40	20	200	100
13	C. A. A. Albrecht...	1901	No. 17 5.25	No 17 8.20	No. 10 8.70	No 17 6.40	No. 14 8.20	No. 17 8.60	No. 13 8.30	No. 22 3.65	No 13 4.30	No. 18 4.50	66.10	50.78	33.29	16.68	166.85	83.43
* 3	J. B. Arthur.........	1901	No. 6 6.09	No. 11 8.60	No. 17 8.10	No. 10 7.12	No. 13 8.30	No. 5 9.20	No. 2 9.20	No. 14 3.95	No. 7 4 55	No. 1 5.00	70.11	55 44	36.83	18.27	180.65	90.33
17	J. Bowes, Jr..	1901	No. 18 5.11	No. 9 8.90	No. 13 8.40	No. 12 7.04	No. 17 7.90	No. 10 8.80	No. 18 8 00	No. 16 3.85	No. 17 4.20	No. 22 4.25	66.45	47.22	33.19	17.03	163.89	81.95
* 4	E. C. Cromwell	1902	No. 3 6.44	No. 8 9 00	No. 8 9 00	No. 17 6.40	No. 2 9 40	No. 10 8 80	No. 8 8.60	No. 2 4 65	No. 10 4.50	No. 1 5.00	70.79	54.96	35.97	†	161.72	89.84
* 2	J. W. Dorsey, Jr.....	1900	No. 1 6.79	No. 2 9 50	No. 2 9.50	No. 6 7 28	No. 1 9.70	No. 1 9.60	No. 1 9.60	No. 4 4.50	No. 3 4 70	No. 17 4.60	75.77	54.76	35 41	16.56	182.50	91.25
* 6	C. A. Edel............	1901	No. 12 5.60	No. 4 9.40	No. 7 9.00	No. 5 7.28	No. 4 8.90	No. 20 8.30	No. 10 8.50	No. 8 4.15	No. 9 4.50	No. 1 5.00	70.63	53.64	35.30	16.72	176.29	88.15
* 9	F P. Fifer.............	1901	No. 2 6.51	No. 3 9 50	No. 4 9.20	No. 7 7 20	No. 12 8.40	No. 6 9.10	No. 5 8.90	No. 9 4.10	No. 5 4.65	No. 1 5 00	72.56	51.28	33.85	16.96	174.65	87 33
* 10	E. Fritz	901	No. 14 5.53	No. 5 9 30	No. 9 8.80	No. 3 7.36	No. 9 8.60	No. 3 9.20	No. 7 8 80	No. 6 4.25	No. 6 4.65	No. 14 4.75	71.24	49 92	33.47	15.81	170.44	85.22
* 1	J. L. Gressitt........	1901	No. 4 6.44	No. 1 9.70	No. 1 9.70	No. 1 7.44	No. 3 9.40	No. 3 9.20	No. 4 9 00	No. 1 4.65	No. 11 4.50	No. 1 5.00	75.03	55.04	36.84	18.37	185.28	92.64

FINAL MERIT ROLL AND FOURTH YEAR RECORD OF GRADUATING CLASS OF 1905—Continued.

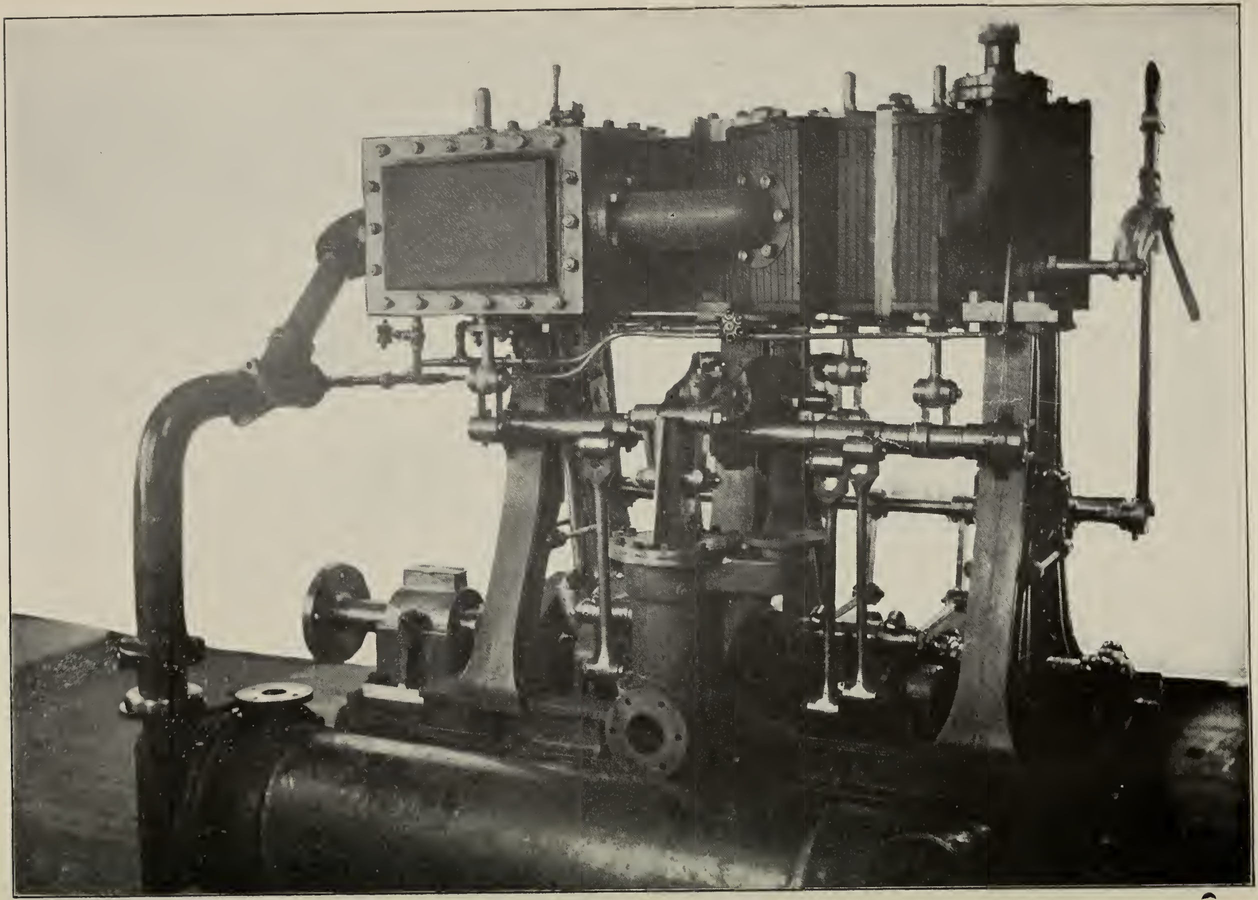
Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 4th Year	Aggregate for 3rd Year.	Aggregate for 2nd Year.	Aggregate for 1st Year.	Aggregate for 4th, 3rd, 2nd, and 1st Years.	Graduating Average.
	MAXIMA	....	7	10	10	8	10	10	10	5	5	5	80	60	40	20	200	100
* 8	R. G. Harris..........	** 1898	No. 7 6.09	No. 7 9 00	No. 3 9.20	No. 7 7.20	No. 5 8.80	No. 14 8.70	No. 9 8.60	No. 7 4.20	No. 2 4 70	No. 22 4.25	70.74	52.49	34.79	§	158.02	87.79
19	E. J. Hecker	1901	No. 21 4.90	No. 14 8.40	No. 24 7.20	No. 20 6.32	No. 23 7.50	No. 19 8.30	No. 25 7.00	No. 13 3.95	No. 20 4.10	No. 1 5.00	62.67	48.20	33.91	17.43	162.21	81.11
* 7	J. H. Hills	1901	No. 8 5.88	No. 6 9.10	No. 16 8.10	No. 2 7.44	No. 11 8.50	No. 15 8.70	No. 17 8.10	No. 12 4.00	No. 8 4.55	No. 11 4.95	69.32	53.32	35.26	17.98	175.88	87.94
12	B. F. Hoffacker.....	1901	No. 12 5.60	No. 11 8.60	No. 4 9.20	No. 9 7.20	No. 10 8.50	No. 13 8.80	No. 14 8.30	No. 20 3.70	No. 12 4.50	No. 1 5.00	69.40	50.84	32.80	16.11	169.15	84.58
20	H. V. D. Hunt	1902	No. 10 5.67	No. 19 8.00	No. 15 8.20	No. 22 6.08	No. 8 8.60	No. 7 9.00	No. 12 8.40	No. 11 4.05	No. 14 4.30	No. 1 5.00	67 30	47.70	30.95	†	145.95	81.08
23	C. A. Langrall........	1901	No. 20 4.97	No. 23 7.60	No. 18 8.10	No. 17 6.40	No. 16 8.10	No. 18 8.50	No. 16 8 10	No. 24 3.50	No. 18 4.15	No. 22 4.25	63.67	47.04	30.72	15.26	156.69	78.35
15	S. May................	1901	No. 9 5.74	No. 16 8.20	No. 12 8.50	No. 25 6.00	No. 6 8.80	No. 12 8.80	No. 11 8.50	No. 15 3.90	No. 23 3.80	No. 20 4.35	66.59	49.32	33.18	16.30	165.39	82.70
18	J. L. Mosher.	1901	No. 15 5.46	No. 24 7.60	No. 14 8.30	No. 22 6.08	No. 7 8.70	No. 16 8.60	No. 19 7.80	No. 16 3.85	No. 16 4.20	No. 15 4.70	65.29	49.86	32.46	16.16	163.77	81.89
16	R. G. Paugborn.....	1901	No. 16 5.32	No. 18 8.10	No. 19 8.00	No. 16 6.64	No. 20 7.70	No. 22 8.30	No. 15 8.20	No. 16 3.85	No. 15 4.30	No. 19 4.40	64.81	50.12	33.67	16.60	165.20	82.60

BALTIMORE POLYTECHNIC INSTITUTE.

FINAL MERIT ROLL AND FOURTH YEAR RECORD OF GRADUATING CLASS OF 1905—Continued.

Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics' of Materials.	Steam Engineering.	Mech Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 4th Year.	Aggregate for 3rd Year.	Aggregate for 2nd Year.	Aggregate for 1st Year.	Aggregate for 4th, 3rd, 2nd, and 1st Years.	Graduating Average.
	MAXIMA	....	7	10	10	8	10	10	10	5	5	5	80	60	40	20	200	100
24	M. Pisani, Jr.........	1901	No. 22 4.90	No. 25 7.50	No. 21 7.50	No. 11 7.12	No. 25 7.00	No. 25 7.30	No 24 7.50	No. 24 3.50	No. 22 3 95	No. 18 4.50	60.77	46.58	31.29	16.25	154.89	77.45
11	L. Small	1901	No 10 5 67	No. 11 8.60	No. 11 8.60	No. 15 6.88	No. 18 7.90	No. 8 8.90	No. 6 8 90	No. 5 4.30	No 4 4.70	No. 15 4.70	69.15	51.64	34.57	14.36	169.72	84.86
14	M. Steinberger......	1901	No. 19 5.04	No. 15 8.30	No. 20 7.70	No. 12 7.04	No. 18 7 90	No. 9 8.90	No. 20 7.70	No. 10 4.10	No. 21 4.00	No. 11 4.95	65.63	49.38	34.32	16.77	166.10	83.05
*** 25	H. DeG. Thurlow...	1901	No 26 4.34	No. 21 7.90	No. 23 7.30	No. 22 6.08	No. 24 7.30	No. 24 7.50	No. 21 7.60	No. 21 3.65	No. 25 3.55	No. 13 4.90	60.12	45.52	29.80	14.64	150.08	75.04
22	H. Waldorf............	1901	No. 22 4.90	No. 20 8.00	No. 21 7 50	No. 21 6.24	No. 22 7.50	No. 23 8.20	No. 23 7.50	No. 23 3.60	No. 19 4.15	No. 1 5.00	62.59	48.16	32.89	16.25	159 99	80.00
* 5	E. L. Willson........	1902	No. 5 6.16	No. 10 8.80	No. 6 9.00	No. 4 7.36	No 15 8.20	No. 2 9.60	No. 3 9.10	No. 3 4.55	No. 1 4.75	No. 1 5.00	72.52	53.18	34.77	†	160.47	89.15
21	A. H. Woollen.......	1901	No. 22 4.90	No. 22 7.80	No. 25 7.00	No. 14 6.88	No. 21 7.60	No 20 8.30	No. 22 7.50	No 19 3.80	No. 24 3.70	No. 22 4.25	61.73	47.88	34.00	17.64	161.25	80.63

§ System not established until later.
† First year at City College under a different system.
** Completed the three-year course in June, 1901. Returned in 1904 to complete the full four-year course.
*** Deficient in Mechanics; allowed a re-examination in September and passed.
* Received 85 per cent. or more of the aggregate multiple for the entire course.



TRIPLE EXPANSION ENGINE.

BUILT BY STUDENTS AFTER DESIGN OF THE BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT.

PART OF AN EDUCATION.

ADDRESS DELIVERED BY PROFESSOR WILLIAM SUDDARDS FRANKLIN, LEHIGH UNIVERSITY, ON THE OCCASION OF THE COMMENCEMENT EXERCISES OF 1905.

(All rights reserved.)

Mr. President, Young Men of the Graduating Class, Ladies and Gentlemen:

It is a pleasure to be with you this evening with greetings from a sister technical school and hearty congratulations to you, my young friends, upon your completion of a course of study the effectiveness of which it has been my good fortune to see exemplified in some of your recent graduates who have been students of mine.

Few among this large audience, I suppose, have had much experience of the wholesale breaking of family ties that accompanied the great westward tide of emigration that reached its flood shortly after the middle of the nineteenth century, and perhaps not one among you has any experience of the complete ignorance of all but the most immediate family connections which is the lot of the native Westerner of this generation. If you will permit me, then, to venture into a realm that is doubly obscured to me by changing time and shifting place, I will add that I feel an especial pride in speaking to a Baltimore audience, having always been told that my father's people came many, many years ago from your city.

An occasion of this kind is a rare opportunity for one to speak to some effect of those more elusive things in education which it is the despair of every serious teacher to compress into courses of study and to give out with deliberate certainty even to the most aspiring students by the daily routine of recitations, lectures and laboratory work.

I confess, however, that I am not equal to the opportunity which presents itself to me, my young friends, as I look into your eager faces bright with the enthusiasm that is stirred by these really solemn ceremonies that center round you on your graduation day; still, I shall attempt to speak to you about a part of an education, the part that children like best and the part that serves best to keep men always young.

Many of you, no doubt, know Robert Louis Stevenson's "Child's

Garden of Verse." I select the most delightfully childish of this dainty collection and the one that suits my present purpose best:

"The friendly cow all red and white
I love with all my heart;
She gives me milk with all her might
To eat with apple tart.

"She wanders lowing here and there,
And yet she cannot stray
All in the pleasant open air,
The glorious light of day."

This age of ours, even though it lacks the rigors of pioneer life, perhaps, indeed, because of this very lack, may, I think, be fairly called an out-door age with its growing delight in forest and stream and its increase of longing for mountain and sea; and I am going to speak to you of the great Land-of-out-of-doors and of its lessons of joy and strength.

To you, my friends, young and unacquainted with grief, that great closed chamber of the soul, everything, I know, is a joyful out-of-doors, where, as Stevenson says, you cannot stray, all in the pleasant open air the glorious light of day; and your fresh enthusiasm, knowing no offense, accepts on one equal footing every aspect and phase of life—men, machinery and meadowed hills. I caution you to retain as you grow older as much as you can of this wide, and let us call it, matter-of-fact tolerance. Accept men and learn kindness and pity, machinery and learn dominion, and keep undefiled the sunlit hills and learn delight in life.

The great Land-of-out-of-doors, what irony there is in such glowing phrase to city boys like yourselves! And yet, if your elders only knew it, there is, for nearly ever city boy, the possibility of a short spell of free out-door life in our Summer Camps for Boys which constitute almost a new departure in education. I wish that every moderately well-to-do parent in our large cities might read an article on this subject in a recent number of the *Outlook.*

The supreme delight of my own boyhood days was to gather wild flowers in a wooded glen to reach which led across a sunny stretch of wild meadow rising to the sky, and I would have you know that I lived as a boy in a land where a weed never grew! Next to this delight in wild flowers and their haunts, my greatest delight was to watch the workings of a great saw mill, to see men play as it seemed to me, eyes following every motion, ears filled with sounds like music in their sufficiency, heart leaping at every kind attention. A favorite uncle worked there for my father, the happiest man I have ever known, and since those early days I have learned but little about machinery, not much worth knowing about men, and nothing at all about meadowed hills!

I wish that every boy and girl might have access to the places where wild flowers grow, and have wide opportunity to see their fathers at work. A hundred years ago these things were really within the reach of every boy and girl, but now, alas, many a bright boy has seen no other manual labor than the digging of a ditch in a cluttered street, while many another, stunted in skill, has almost become a part of the machine he daily tends, and Boyville has become a paved and guttered city, high walled, desolate, and dirty; with here and there a vacant lot hideous with refuse in early spring, and overwhelmed with an increasing pestilence of weeds as the summer days go by; and the strangest thing about all this is the much too matter-of-fact tolerance among young people that accepts unquestioningly and even with manifestations of joy just any sort of a world if only it is flooded with sunshine.

> "As the boy desireth the woods and the water-brooks,
> So doth the man long for Thee, O God."

I suppose that I am as familiar with the requirements of modern industry as any man and as ready to tolerate everything that is economical wise, but a short time ago in speaking to a group of Bethlehem boys and girls of the delights of outdoor life I could not but be reminded that every day as I walk to and fro I see our Monocacy Creek covered with a scum of gas works tar, and then in crossing the river bridge, I see a half-mile-long heap of rotting refuse serving the Lehigh as a bank on its southern side; not all furnace refuse, either, by any means, but nameless stinking stuff cast off by an indifferent and careless population and lazily left in their very midst in one long unprecedented panorama of putrescent ugliness. And when on splendid autumn days the nearby slopes of old South Mountain lift the eye into pure oblivion of these distressing things I see anon a line of flikering fire creeping through the scanty woods. This I have seen every autumn since first I came to Bethlehem and some of the young people to whom I was speaking had perhaps helped to set those annual fires which soon will leave the mountain bare.

It is easy to speak in amusing hyperbole of refuse heaps and of brooks befouled with tar, but these fires are wanton and wicked beyond any possible touch of humor. It is, indeed, unfortunate, for our young people that their river is not fit to swim in; I know it is not for I have tried it, and I am not fastidious either, having lived an amphibious boyhood on the banks of the muddiest river in the world; but it is a positive disgrace that the river is not fit to look at, that it is good for nothing whatever but to drink, much too good one would think for young people who annually set fire to their only accessible stretch of mountain woods.

Believe me, my young friends, that I only thus indict the young people of my own town—and among them are many of my most valued personal friends—I only indict them that I may say that nothing better can be expected of them, and that, perhaps, nothing better can be expected of the young people of Baltimore.

I remember how in my own boyhood the rare advent of an old tin can in my favorite swimming hole used to offend me immeasurably, while such a thing as a cast off shoe was simply intolerable, and I do not wonder that the unquenchable delight of boys in out-door life, with its natural contempt for restraint, becomes an absolute rage in its indifference to the dreadful pollution of the streams and to the universal pestilence of weeds and refuse in our thickly populated districts.

I cannot refrain from quoting an amusing poem of James Whitcomb Riley's which expresses, more completely than anything I know, the delight of boys in life out-of-doors where so many things happen and so many things lure, and you can easily catch in the swing of Riley's verse that wanton note which is ordinarily so fascinatingly boyish, but which may too easily turn to a raging indifference to everything that makes for purity in this troubled life of ours.

THE THREE JOLLY HUNTERS.

O there were three jolly youngsters;
And a-hunting they did go,
With a pointer dog, and a setter dog,
And a yaller dog, also.
Looky there!

And they hunted and they hal-looed;
And the first thing they did find
Was a dingling, dangling hornet's nest,
A-swinging in the wind.
Looky there!

And the first one said, "What is it?"
Said the next, "Let's punch and see."
And the third one said, a mile from there,
"I wish we'd let it be.
Looky there!" (showing the back of his neck.)

And they hunted and they hal-looed;
And the next thing they did raise,
Was a bobbin bunnie cotton-tail
That vanished from their gaze.
Looky there!

One said it was a hot base ball,
Zippt through the brambly thatch.
But the others said 'twas a note by post
Or a telegraph-dispatch.
Looky there!

So they hunted and they hal-looed;
  And the next thing they did sight,
Was a great big bull dog chasing them,
  And a farmer, hollerin' "Skite."
    Looky there!

And the first one said, "Hi-jinktum!"
  And the next, "Hi-jinktum-jee!"
And the last one said, "Them very words
  Has just occurred to me!
    Looky there!" (showing the seat of his pants.)

This kind of hunting is better, I assure you, than the kind that needs a gun, and to one who falls into the habit of it the gun is indeed a useless tool. I remember a day I spent with a gun at a remote spot in the Rocky Mountains where, during the twenty-five days that I have camped there on four different trips, I have seen as many as a hundred and fifty of the wildest of animals, the Rocky Mountain sheep, being almost run over once by a group of five. On the day in question I became so interested in killing mosquitoes—I timed myself at intervals during the three hours that I lay in ambush, eighty per minute for three hours, making an honest estimate of 14,400—I became so interested, I say, that the sheep came, three of them, and were out range again before I saw them, and I was hungry too. I fancy that they were not frightened, but wished the good work to go on undisturbed.

"Ich ging im Walde
  So fur mich hin,
Und nichts zo suchen
  Das war mein Sinn."

If you "go to the woods just for nothing" as Goethe says you may indeed bring home a "flower" that will continue to bloom in your own garden, good cheer and delight in life.

But I must not try your patience by wasting words upon this familiar phase of the Land-of-out-of-doors, especially in this month of June, when the simple reality of that flowery realm fills every heart with joy—

The grass so little has to do,
  A sphere of simple green,
With only butterflies to brood
  And bees to entertain.

And stir all day to pretty tunes
  The breezes fetch along,
And hold the sunshine in its lap
  And—bow to everything.

And thread the dew all night, like pearls,
  And make itself so fine,
A duchess were too common
  For such a noticing.

And even when it dies, to pass
  In odors so divine
As lowly spices gone to sleep,
  Or amulets of pine.

And then to dwell in sovereign barns
  To dream the days away,
The grass so little has to do,
  I wish I were the hay!

What I have thought to tell you about this evening is not however this near by and joyful out-door land but a more distant and difficult one. I wish to tell you very briefly of a trip I took ten years ago with a boy friend who has recently finished his eight years of college and professional study, and who in writing to me some months ago declared that his first and greatest lesson in self-reliance was our Tramp Trip through the Rockies of Colorado and Wyoming.

Hurrying away before the close of the college term we left the prairies of Iowa to spend a short vacation in the mountains, arriving in Denver on a perfect, cloudless morning in June. We had kept an eager westward watch across the even plains since early daylight to catch a first glimpse of the great Front Range of the Rocky Mountains with its covering of summer snow. In Denver we made a few small purchases of fishing tackle and ammunition, and sat through the late afternoon on Capitol Hill to see the crystal day turn to crimson glory as the sun sank slowly behind the bank of shadowy mountains, melting their snow fields into liquid gold.

I often wonder how Emily Dickinson, who never even saw the Alps from Berne in Switzerland, could in four lines touch the compass of a Kansan's emotion at the sight we saw that afternoon from Denver—

"This is the Land that the Sunset washes,
  Those are the Banks of the Yellow Sea
Where it arose and whither it rushes
  This is the Western mystery."

Late in the evening we took the train for Loveland, a small town about forty miles north of Denver, where the next morning we purchased a pony and a pack saddle and started on our tramp, impatient to get into the mountains.

I wish I could tell you the details of our trip. It was hard, of course, like four other tramping trips I have made, two in the Rockies, one through the Alps, and one through the Adirondacks, and it was lonesome, but strangely fascinating. Perhaps the most insistent feature of the trip, accentuated by an occasional letter telling of the pies and cakes they were making at home, was that we fell into that attitude towards nature which I imagine Indians have, namely, the desire to get something to eat out of everything we saw. This is not greediness by any means, for a measured appetite is essentially incompatible with the conditions of Indian life. In fact, the only wild animals which are not gourmands on occasion are those which eat grass. Of course, we were, at best, only Agency Indians, but we were certainly off our reservation.

Two days' tramping from Loveland over a good stage road brought us to Willow Park, a level stretch of low-lying grass land immediately north of Long's Peak and almost surrounded by high snow-covered mountains. Here we stayed in camp for two days, making runs up to timber line as preliminary exercise, and then we made our way to the head waters of the Grand River where the Front and Medicine Bow ranges meet in a vast jumble of mountains. We moved about slowly for several days in this high region, and spent one day on a flying trip down the Grand River to a settlement at Grand Lake to replenish our store of bacon and flour.

From the head waters of the Grand River we crossed the Medicine Bow Mountains to that excessively desolate stretch of rolling country known as North Park. Crossing this strange park in a westerly direction we entered the range of the Rabbit Ear and crossed to the head waters of the Green River, then we recrossed the Rabbit Ear Mountains, passed over the Medicine Bow Mountains a second time, and reached Laramie in Wyoming.

When we first struck camp in the southern edge of North Park the smoke from our camp fire attracted the attention of a lone mountaineer who had built his shanty conveniently near to the hunting grounds in the Medicine Bow Mountains. He thought we were the toughest "tender-foots" he had ever seen. He approved of us, there was no doubt about that, and for two weeks he traveled with us just for the pleasure of our company. He had a fresh carcass of venison at his shanty when we first fell in with him and we paid our respects to that venison in a way that must, I think, be left to your imagination.

When traveling above timber line we were on snow much of the time; below timber line, at high altitudes, we contended about equally with snow and fallen timber; and at middle altitudes where fires have been frequent and disastrous, the fallen timber alone was quite enough to make travel troublesome. Mud and water we encountered everywhere, but without much concern. The greatest vexation to the amateur traveler in the Rockies is to slip off a log in trying to cross a stream and thus get wet all over when one might have been wet only to the middle—an awkward comrade of mine on a trip I took sixteen years ago did this so many times that it became a standing joke, and still 'Gric, as we called him, that is to say, Agricola, after his father, "Farmer" Funston of Kansas, had sand enough left to take him through Death Valley in Southern California, to take him all alone 1,600 miles down the Yukon River in an open boat, to take him into the Cuban Army where he received three serious wounds, and finally, to take him to and through the Philippines with our volunteer army—and the thing which verges most nearly upon discomfort is to sleep in the rain at snow line; indeed, if it were not for the camp fire this would be distinctly uncomfortable.

When we reached the edge of the Laramie Plains after our second crossing of the Medicine Bow range we had been in the mountains for thirty-one nights and we had tramped more than three hundred and fifty miles since leaving Loveland. A large portion of the time was spent at high altitudes where the weather is not lamb-like in June, and no small portion of the three hundred and fifty miles was mud and water, snow and fallen timber, through a country as rough, perhaps, as any in the world and as interesting. The only way to study geography is with the feet! No footless imagination can possibly grasp the sublimity of western mountain and plain, nothing but a degree of hardship can measure their widespread chaos and lonely desolation, and only the freshened eagerness of many mornings can perceive their matchless glory.

I am often amused at a certain pervasive pity which an early native of the far western prairies meets with here between the Alleghanies and the sea, for, indeed, such nativity has its compensations, limitless freedom, a certain and insidious worship of grass-land, storm-cloud, and sunset sky, and an aptness to learn the lessons of that more distant and difficult land—

"Prairie born;
Once his feet touch the slope of Western Mountain,
The level road they ever more shall spurn.
If once he drink from snow-pure crystal fountain
His thirst shall, ever more consuming, burn
With deepened draughts from common stream.

Once his eye catch glimpse of more substantial glory
Than prairie horizon high-piled with clouded foam,
His quickened yearning shall inspire old story
Of unbounded, deathless realms beyond the sunset—Home."

Often on my mountain trips, hungry and foot-sore, my fancy has turned to what my friend 'Gric told me years ago of the utterly desolate Funeral Mountains that border Death Valley in southern California and of the infinite sunshine there. What would you think, my friends, even now in this time of joy and gladness, if you could hear a trustworthy account of an actual trip over those dreadful Mountains and into that awful Valley!

I do not wish, however, to impress upon you even a tinge of that strange and not always wholesome yearning that I have just hinted at, but rather to stir to some extent your wakening sense of the wonderful reality and all but absolutely incredible greatness of life itself. It is, indeed, only the utterly dreary and ruthless aspect of the mountains that appeals to me as a symbol of the mystery and desolation of death. To every one who retains some elements of eager enthusiasm the mountains must always stand I think as an image of the highest and most enduring things of life. The man whose love of the mountains can face hardship is like the man whose love of righteousness can face severe trial and acute distress. There is nothing in this world worth seeing that such men may not see, there is nothing in this life worth knowing that such man may not know, nor any depth of feeling that such men may not sound.

Your lives, my young friends, are set in the last, leaping years of an age when men's minds have, perhaps, been turned too much away from the greater realities of life in the most complete and wonderful test the world has ever seen of the efficacy of our dominion over material things to satisfy the human soul; and yet, seeing some of these greater things, I often wonder at the necessarily futile fret of men who would escape the severe constraint that must continue to bear with an increasing stress upon the souls of men as this important material dominion widens. You who have now completed a course of technical training are not likely to seek escape, at least, I can assure you that if you permit the decay of those precise and exacting modes of thought which you have acquired in your study of the sciences your escape will only be that of a lagging soldier.

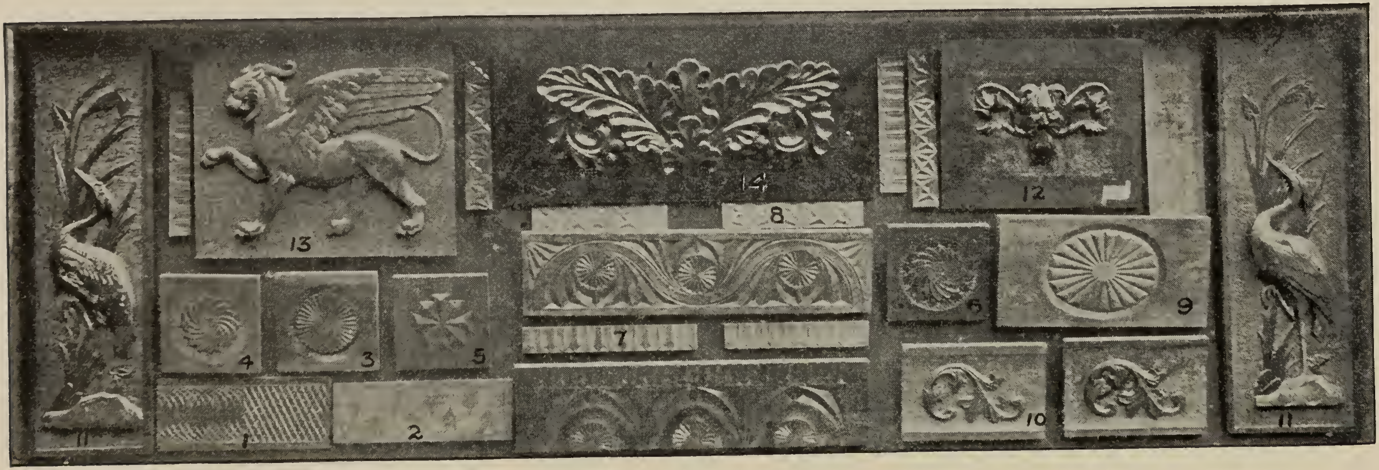
Have you ever read of that remarkable little animal, the axolotl, a kind of salamander, that lives a tad-pole like youth and never changes to the adult form unless a stress of dry weather annihilates his watery world? Ordinarily, he lives and reproduces his kind as a tad-pole, and a very funy looking tad-pole he is with his lungs hanging from the sides of his head as two great feathery tassels, brownish in tint from the red blood inside and the dark mud that settles on the outside of the tiny tube-like streamers. I caught one of these strange creatures when I was a boy and caged it in an aquarium, and I was greatly interested years afterwards to learn more about it and to be told that it is a very rare animal, indeed, in my native state, although plentiful enough in Mexico. When the aquatic home of the axolotl dries up he quickly develops a pair of internal lungs, lops off his tassels and begins a new mode of life on land. If you, my young friends, are ever to develop beyond the tadpole stage and become complete men, according to the present day significance of that term you must meet, with quick and responsive inward growth, that new and increasing stress of dryness as many men are wont to call our modern age of science and industry.

It seems to me, however, that it is not entirely just to declare that our fathers have been too much occupied with the material aspects of life. Such a declaration does not sufficiently acknowledge our debt to their evident sacrifice. Anyway the history of our race is a succession of periods of severe schooling, face to face with nature, followed by sudden widenings of a consciousness

"That never knows how high we are
Till we are called to rise;
And then if we are true to plan
Our statures touch the skies."

My young friends each of you now stands at the open gate of life. Do not turn from it "to shut yourself within a garden wall content to play with the fringes of its guarded flowers and lift their drooping heads with a smile upon your face and no cloud upon your brow," never to know that outside your little place of peace majestic mountains rise in rugged path to touch the sky, nor care that beyond that rose-banked wall to the very mountains' base the parched wild grass is torn by the agony of men and beat level by the drift of their life blood. Do not turn, I say, but pass on through to that limitless land of out-of-doors and a world of wilderness and of woe; only take heed of the 'call to rise' which to hear is the whole of education and to follow is the whole of life.

"Superiority to fate
Is difficult to learn.
'Tis not conferred on any
But possible to earn,
A pittance at a time,
Until, to her surprise,
The soul, with strict economy,
Subsists till Paradise."



WOOD CARVING.

SOME OF THE EXAMINATION PAPERS SET IN 1904-1905.

ANNUAL EXAMINATION IN STEAM ENGINEERING.

FOURTH YEAR CLASS, MAY 23, 1904.

1. The accompanying diagram was taken with a 40 spring from the high speed engine of the Polytechnic Institute. Assuming that the steam consumed per unit of power as determined from indicator diagrams is 75 per cent. of the actual consumption, it is required to find from this diagram the number of pounds of steam the engine was consuming per I. H. P. per hour.

2. Stroke of engine, 24 inches; initial absolute pressure of steam at cylinder, 100 lbs., but wire-drawing reduces the pressure to 95 lbs. at cut-off. Back pressure, 18 lbs.; cut-off, ¼ stroke; clearance, 10 per cent. Release takes place at 90 per cent. of stroke, and exhaust closes after 75 per cent. of the return stroke is completed. The expansion and compression being hyperbolic, construct the expected indicator diagram, and find the terminal pressure, p'_2; the final pressure of compression, p_c; and the mean effective pressure, p_e, the latter by means of ordinates.

3. An engine, 18.5″ x 30″, makes 129 revolutions per minute. The mean effective pressure is 36.6 lbs. per square inch, and the consumption of coal per I. H. P. per hour is 3 lbs. The weight of steam used per stroke is 0.3478 lbs. Find the number of pounds of steam used per I. H. P. per hour; the coal consumption (long tons) per day; the number of pounds of water the boiler must evaporate per pound of coal.

4. An engine is to develop 46 I. H. P. at a piston speed of 625 feet per minute. Absolute steam pressure, 95 lbs.; cut-off, 0.25 stroke; back pressure, 2 lbs. above atmosphere; clearance, 5 per cent. Find the necessary diameter of the cylinder, and, assuming a suitable stroke, determine the revolutions per minute.

5. What are the primary objects in testing engines and boilers? Describe briefly how to weigh the feed water during a test. Trace the course of the steam in its passage through a triple expansion engine and surface condenser until its final return to the boiler.

6. Crank angle at cut-off, 105 degrees; lead angle, 8 degrees; maximum port opening to steam, ⅞ inch. Find by means of a Zeuner diagram, the travel of the valve, the lap, the lead, and the angular advance of the eccentric.

7. What are the necessary attachments to a boiler? The steam pressure in a cylindrical steel boiler is to be maintained at 210 lbs. per square inch. Diameter of shell, 14 ft., and the efficiency of the riveted joint 85 per cent. Using a factor of safety of 4, it is required to find the necessary thickness of shell.

SEMI-ANNUAL EXAMINATION IN MECHANICS.

FOURTH YEAR CLASS, JANUARY 30, 1905.

1. A rod 11" long has a weight of 7 ounces at one end, and a weight of 8 ounces at the other end, and is found to be in equilibrium when balancing on a fulcrum 5" from the heavier weight. If the weights are interchanged the fulcrum must be shifted 11/17 of an inch. Find the weight of the rod, and the position of its centre of gravity.

2. Two scale pans are suspended from the two ends of a straight lever whose arms are as 3 to 4, and an iron bar of 20 pounds weight is laid on the scale pans, and will just reach from the one to the other; find what weight must be placed into one scale to preserve equilibrium.

3. Two equal weights are attached to the ends of a string which is laid over the top of two equally rough planes, having the same altitude and placed back to back, the angles of inclination of the planes to the horizon being 30° and 60°, respectively. The weights being just on the point of moving, find the coefficient of friction.

4. A beam capable of moving about one end is kept in a position inclined to the horizon at an angle of 60° by a string attached to the other end; the string is inclined to the horizon at an angle of 60° in an opposite direction: compare the tension of the string with the weight of the beam.

5. The foot of a derrick pole of 240 pounds weight rests on the ground, and a weight of 2 tons is suspended from the other end of the pole. The length of the pole is 22 feet, and it is kept in position by a guy rope 28 feet long, fastened to the ground 12 feet to the rear of the foot of the pole. Find, graphically or otherwise, the tension of the guy and the thrust of the boom. Scales for graphic solution:—⅛ inch = 1 ft., and 1/16 inch = 100 lbs.

6. A body starting from a given point, moves vertically downwards at the rate of 32.2 feet per second. After 4 seconds a heavy body falls from the same point under the action of gravity. Show that it will overtake the first body at a distance of 257.6 feet from the starting point.

7. A stream of water passes over a dam and falls through a vertical height of 16 feet, the transverse section of the stream at the foot of the fall being one square foot; find the H. P. that is constantly developed, taking the weight of a cubic foot of water as 62.5 pounds.

8. A flat plate, ABCDE, is right-angled at A, the sides AB and AE being 12″ and 9″, respectively. The corner C is distant 14″ from B and 9″ from E. The side ED is 8″ long, and the point D lies in the prolongation of the line joining B and E. Locate graphically the c. of g. of the plate, and give its distance from the corner A. Scale of lengths, ¼; scale of areas, 1/16 inch = 1 square inch.

9. Determine the H. P. that may be transmitted by a belt 6 inches wide and ¼ inch thick, running at a speed of 60 feet per second, the tension in the slack side of the belt being 0.45 of that in the tight side, and the stress allowed being 280 lbs. per sq. inch of section. To what extent will the effect of centrifugal action reduce this power?

10. The wheelwork of a crane consists of a pinion of 12 teeth, driven by a lever handle 18″ long, gearing with a wheel of 92 teeth, and of a pinion of 14 teeth gearing with a wheel of 72 teeth on the drum axle. The diameter of the drum is 18″, the power applied to the handle 60 lbs., the pitch of the teeth 1.25″, and the handle makes 20 revs. per min. Find the weight lifted, the tangential pressures between the teeth of the wheels in contact, and the H. P. transmitted through the train.

MECHANICS OF MATERIALS.

FINAL EXAMINATION.

FOURTH YEAR CLASS, MAY 12, 1905.

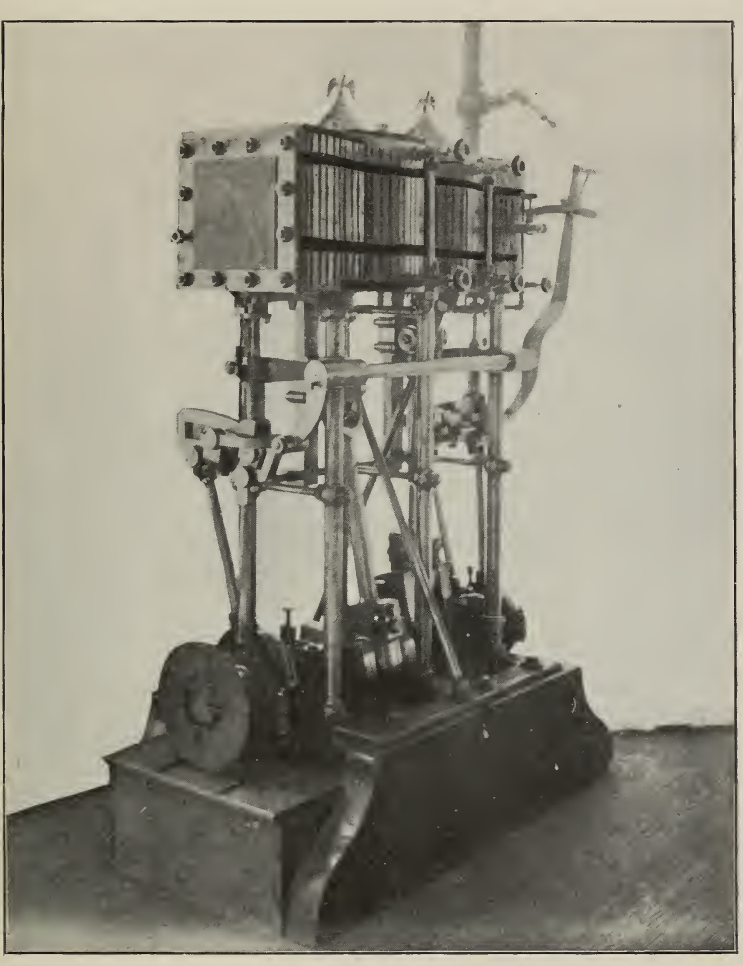
1. Heavy 12 inch Cambria I beams of 24 feet span are to support a floor bearing a uniform load of 125 pounds per square foot, the maximum fibre stress not to exceed 16000 lbs. per square inch. At what distance apart should the beams be placed?

2. What safe uniform load, exclusive of the weight of the beam itself, can be placed on a wooden cantilever 9 feet long, 3 inches wide, and 6 inches deep, the maximum stress not to exceed 900 lbs. per square inch?

3. What safe uniformly distributed load can be placed on a standard Cambria channel beam weighing 40 lbs. per foot, the span being 16 feet, the web placed vertical, and the fibre stress not to exceed 16000 lbs. per square inch?

4. A column of timber of square section, 14 feet long, and with fixed ends, is to support a steady load of 12 tons. Find the dimensions of the section.

5. Compare the strengths and weights of two steel shafts of the same length—one solid and 9 inches in diameter, the other hollow and 9.25 inches in diameter with a 5 inch axial hole.



COMPOUND ENGINE.

BUILT BY STUDENTS AFTER DESIGN OF THE BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT.

6. A 10 inch Cambria I beam, weighing 25 lbs. per foot, is laid across an opening of 16 feet. In addition to a concentrated load of 1000 pounds at the middle, it bears a uniformly distributed load of 16000 pounds. Find the maximum fibre stress and the maximum deflection, taking E as 29,000,000.

MATERIALS OF ENGINEERING.

FOURTH YEAR CLASS, FEBRUARY 3, 1904.

1. What metals are used in forming alloys suitable for engineering purposes? What names are given the resulting compositions?

2. In the classification of iron and steel, what metals are known as malleable, semi-malleable, and non-malleable?

3. How is the quality of cast-iron affected by the different methods and fuels employed in its reduction? From what source does cast-iron absorb much carbon? What is the difference in character of cast-iron containing a high percentage of graphitic carbon and that containing a high percentage of combined carbon? What brand of pig-iron is much used in castings requiring the maximum of strength?

4. How can cast-iron be made partly malleable? Sketch and give dimensions of specimens of cast-iron for compression, transverse, and tensile tests. Give, as a result of your experience in testing, the average crushing, transverse, and tensile strengths of cast-iron in pounds per square inch.

5. By what process is the most of wrought-iron produced? What element is nearly eliminated from the iron by this process? State some of the properties of wrought-iron. When testing wrought-iron, what have you found to be the tensile strength per square inch, and the percentage of elongation in 8 inches?

6. By what process is wrought-iron converted into the high-grade steel known as tool steel? What is the process for converting cast-iron into mild, or structural, steel? Which of the two methods for converting cast-iron into structural steel is preferable when the material is to be used in the construction of boilers and shafting? Explain what is meant: (*a*) by the basic process; (*b*) by the acid process.

7. What impurities, other than carbon, are contained in steel? How are the strength and ductility of steel affected by the amount of carbon it contains? What is semi-steel?

8. Describe the different physical tests for structural steel. Make a sketch showing the forms and dimensions of specimens used for testing steel for boiler plates and for steel forgings. Given a forged steel specimen finished to ¾″ diameter and 2″ between centre dots; how would you proceed with the test?

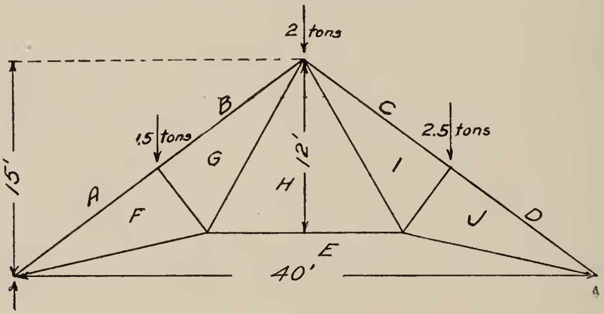
GRAPHIC STATICS.

FOURTH YEAR CLASS—MAY 17, 1905.

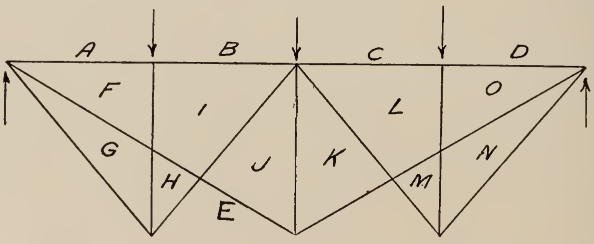
1. A cantilever, 14 feet long is loaded uniformly with 30 pounds per foot and has, in addition, a concentrated load of 150 lbs. at its extremity and one of 200 lbs. at 9 feet from the wall. Construct the bending-moment and shear diagrams. Scales: Linear, ¼ inch equals 1 foot; load, 1 inch equals 400 pounds.

2. A beam, supported at the ends, is 20 feet long, weighs 400 lbs., and has concentrated loads of 360 lbs. and 440 lbs. at 8 feet from the left end and 4 feet from the right end, respectively. Draw the bending-moment and shear diagrams, and measure the bending moments under the concentrated loads and the shear stress at the middle of the beam. Scales: Linear, ¼ inch equals 1 foot; load, 1 inch equals 200 lbs.

3. Draw the reciprocal diagram of the roof truss shown in the figure and loaded as shown. Tabulate the magnitudes of the stresses in the members, and indicate their kinds in the frame diagram by means of arrow heads. Find the stress in BG by means of a Ritter section. Scales: Linear, ⅛ inch equals 1 foot; load, ½ inch equals 1 ton.



4. The Fink truss shown in the figure has a span of 40 feet, loaded with 2 tons to the foot, and has a depth of 12 feet. Draw the reciprocal diagram and tabulate the magnitudes of the stresses in the members, indicating their kinds in the frame diagram. Find the stress in HI by means of a Ritter section. Scales: Linear, ⅛ inch equals 1 foot; load, 1-20 inch equals 1 ton.



5. From two points, A and B, in a wall, B being vertically over A and 10 feet from it, project horizontally two bars, AD and BC, 9 ft. and 15 ft. in length respectively. Points B and C are joined bv bars with D. BC is uniformly loaded with 50 lbs. per foot, and from C is hung a weight of 1000 lbs. Find the stresses in all the bars, indicating their kinds in the frame diagram. Show that the horizontal reactions at A and B are equal and opposite. Scales: Linear, ¼ inch equals 1 ft.; load, ¼ inch equals 100 lbs.

STEAM ENGINEERING.

THIRD YEAR CLASS, MAY 24, 1905.

1. Make a sketch of a Return Tubular boiler. Name the various parts.

2. Make sketches of a safety stay bolt, a diagonal stay, and a girder stay. Where are these stays placed in boilers?

3. Sketch and describe the action of a Little Giant Injector.

4. Name and sketch two of the expansion joints commonly used to take up the expansion between anchored points in a steam line.

5. Stroke of engine, 24 inches; initial absolute pressure of steam at cylinder, 100 lbs., but wire-drawing reduces the pressure to 95 lbs. at cut-off. Back pressure, 18 lbs.; cut-off, ¼ stroke; clearance, 10 per cent. Release takes place at 90 per cent. of stroke, and exhaust closes after 75 per cent. of the return stroke is completed. The expansion and compression being hyperbolic, construct the expected indicator diagram, and find the terminal pressure, P_2; and the final pressure of compression, P_c.

6. The pulley of a dynamometer is 26 inches in diameter. The revolutions of the engine are 300 per minute, and the length of the beam from the center line of shaft to the point of application of the pressure on the scales is 100 inches. What pressure will the scales register when the engine is developing 70 brake horse power?

7. The accompanying diagrams were taken with number 40 springs from a Payne high speed engine in the Lehigh University Boiler House. Diam. of cyl., 7 inches; stroke, 8 inches: diam. of piston rod, 13-16 inches; revolutions per minute, 254. Find the indicated horse power.

8. Make a sketch of the Meyer expansion valve, and explain its action.

DIFFERENTIAL CALCULUS.

FOURTH YEAR CLASS—FEBRUARY 15, 1904.

(Ten of the twelve questions are required.)

1. Give the definition and an illustration of a derivative.

2. Given $y=\frac{e^x}{1+e^x}$ find $\frac{dy}{dx}$.

3. Derive the formula for the differentiation of $\tan^{-1} u$.

4. Expand $\cos (x+a)$ in a power series of a.

5. Evaluate $\frac{\log (1+x)}{x}$ when $x=\infty$.

6. An open tank is constructed with a square base and vertical sides. Show that the area of the entire inner surface will be least if the depth is half the width.

7. A circular plate of metal expands so that its diameter increases uniformly at the rate of 0.002 of an inch per second; at what rate is the surface increasing when the diameter is 5 inches?

8. Express $\frac{d^2y}{dx^2}$ in terms of $\frac{dx}{dy}$ and $\frac{d^2x}{dy^2}$.

9. Find the intercepts made upon the axes by the tangent at (x_1, y_1) to the curve $\sqrt{x}+\sqrt{y}=a$; and show that their sum is constant.

10. Given $\rho=\cos\theta$, find $\frac{ds}{d\theta}$.

11. Examine the curve $y(a^4-b^4)=x(x-a)^4-xb^4$ for a point of inflection.

12. Explain what is meant by the measure of curvature at a given point. Derive the formula.

INTEGRAL CALCULUS.

FOURTH YEAR CLASS—MAY 25, 1904.

(Ten of the twelve questions are required.)

1. Find the equation of the curve in which, for any point, the length of the subtangent varies as the square of the length of the ordinate.

2. Integrate $(12x^2-12xy+3y^4-42bx^6)\,dx+(12xy^3-6x^2-35ay^4)\,dy$.

3. Integrate $(2x-2)(x^2-2x+5)\cos(x^2-2x+5)\,dx$.

4. Find the total area included between the curve $y=x^3$ and the line $y=4x$.

5. Find the equation of the curve in which, for any point, the length of the polar subtangent is proportional to the length of the radius vector.

6. Find the areas included between the parabolas $y^2=4ax$ and $x^2=4ay$.

7. $\int_a^{2a} \frac{\sqrt{x^2-a^2}}{x^4}\,dx$.

8. Derive a formula for the integration of $x^M\left(a+bx^N\right)^P dx$.

9. $\int_0^{\frac{\pi}{2}} \int_a^b \int_0^{\pi} \sin x\,(dx)^3$

10. Find the volume of a right conoid with an altitude h and a circular base of radius b.

11. Find the mean length of the ordinates of a semi-circle of radius a, the ordinates being drawn at equidistant intervals on the diameter.

12. Find the radius of gyration of a uniform circular cylinder about its diameter.

SPHERICAL TRIGONOMETRY AND SURVEYING.

THIRD YEAR—MAY 27, 1904.

1. In a right spherical triangle prove $\tan^2\frac{B}{2}=\frac{\sin(c-a)}{\sin(c+a)}$.

2. Find b, A and B in a right spherical triangle when $c=55° \; 9' \; 32''$ and $a=22° \; 15' \; 7''$.

3. In an oblique spherical triangle prove

$$\cos a=\cos b \cos c+\sin b \sin c \cos A.$$

4. Given $b=63° \; 15' \; 12''$, $c=47° \; 42' \; 1''$, $A=59° \; 4' \; 25''$; determine B, C and a.

5. Explain fully how to measure across a body of water, using only a chain.

6. Make a sketch of a portion of a leveling rod, showing the position of the vernier when the reading is 4.873 feet.

7. Reading angles, making use of the vernier.

8, 9, 10. Compute the area and make a plot from the following notes:

STATIONS.	BEARINGS.	DISTANCES.
1	S. 20°45′ E.	13.11 chains.
2	N. 48°15′ E.	13.62 chains.
3	N. 43°45′ W.	4.73 chains.
4	N. 45°15′ W.	4.75 chains.
5	S. 51°30′ W.	2.53 chains.
6	S. 72°30′ W.	6.56 chains.

ANALYTIC GEOMETRY.

THIRD YEAR CLASS—MAY 20, 1904.

(Ten of the twelve questions are required.)

1. One end of a line, whose length is 15, is the point (—4, 8) and the ordinate of the other end is 3. What is its abscissa?

2. A point moves so that its distance from the axis of X is half its distance from the origin; find the equation of its locus and discuss it.

3. Derive the Symmetrical Equation of the straight line.

4. Find the equation of the tangent to the circle $x^2+y^2=r^2$ in terms of its slope.

5. Derive the four forms of the polar equation of the circle.

6. Transform the equation $x^2-y^2+6=0$ by turning the axes through 45°.

7. Derive the equation of the diameter of the parabola $y^2=4px$, $y=mx+b$ being a chord of the diameter.

8. What is the ratio of the two axes if the centre and the foci of an ellipse divide the major axis into four equal parts?

9. Discuss the equation of the hyperbola.

10. Show that the sum of the squares of any pair of semi-conjugate diameters of an ellipse is equal to the sum of the squares of its semi-axes.

11. Derive the equation of an hyperbola referred to its asymptotes as axes of coördinates.

12. Find the equation of the Witch of Agnesi.

PLANE TRIGONOMETRY.

THIRD YEAR CLASS—FEBRUARY 17, 1904.

1. Give the values of the six trigonometric functions of 0°, 30°, 45°, 60°, 90°, 120°, 135°, 150° and 180°.

2. Determine x if $2 \cos x + \sec x = 3$.

3. In a unit circle what is the length of a chord corresponding to an angle of 45° at the centre?

4. Derive the formulas for $\cos\frac{1}{2}A$ and $\sin\frac{1}{2}A$.

5. Prove the law of cosines.

6. What is the base of the system when $\log 0.008 = -1.5$?

7. Find the area of a parallelogram if its diagonals are 2 and 3 respectively, and intersect each other at an angle of 30° 40′ 50″.

8. Solve the triangle, given $a=48.76$, $b=62.92$, $c=80.24$.

9. The area of a right triangle is 6 and the sum of the three sides is 12; solve the triangle.

Prove that $\cos(2 \sin^{-1}x) = 1-2x^2$.

EXAMINATION IN ELECTRICITY.

FOURTH YEAR CLASS—FEBRUARY 3, 1905.

1. Derive a formula for the ratio of the size of the hole in core stamping to the diameter of the armature of a four-pole dynamo.

2. The total number of conductors on the surface of a loop wound armature of a four-pole dynamo is 632. The electromotive force required is 250 volts at 1050 R. P. M. What will be the magnetic density in the magnet limb whose diameter is 6 inches, the coefficient of leakage being 1.3?

3. Give the scheme for two-circuit winding of an armature for a four-pole dynamo, the total number of conductors being 34.

4. The winding space on each of the magnets of a dynamo is 5 inches long and 2 inches deep. The conductors are considered as 64 per cent. copper, the remainder being insulation. If current density is to be one ampere to 1000 circular mills, what must be the value of the current, the number of turns on the magnet being 1120? What is the resistance of each spool if each magnet is to receive 25 volts?

5. State how a dynamo would act if an open-circuit existed in one of the armature coils. How could temporary repairs be made?

6. Outline the design of a shunt wound motor to deliver 25 H. P. at 1000 R. P. M., the efficiency of conversion being 90 per cent. and the electrical efficiency 91 per cent. The motor is to be operated on a 250 volt circuit and has a field loss of 2.5 per cent.

7. Discuss the operation of a shunt wound motor on a constant E. M. F., giving its starting and regulating qualities.

8. Draw the diagram for the action of a transformer whose primary coil has a resistance of 40 ohms and reactance 100. The E. M. F. is 1000, the ratio of transformation 20, and the secondary current 10 amperes. Scale, 1-32 inch=10 volts. In what particular is this transformer poorly designed? Ascertain the value of the primary current by measurement.

9. State the principal points in the design of a transformer.

10. When is it necessary to use a rotary transformer? What is the commercial advantage of transformers?

FOURTH YEAR CLASS—MAY 26, 1905.

1. Four thousand horse-power are to be delivered at a distance of 10 miles. Calculate the total circular mils of the conductors to be used to allow a loss of 10 per cent. of the power delivered, comparing the sizes when the voltages at the terminals of the motors are 1000 and 10,000 respectively.

2. Sketch a switch-board of a railway power-house, showing the generator panel and two distributing panels, including all the ordinary switch-board instruments. Show booster connections on one distributing panel.

3. A trolley line is 10 miles long with the power station midway the line. A four-minute schedule is to be maintained, with an average speed, including stops, of 10 miles an hour. Each car will require an average current of 40 amperes at 500 volts. Calculate the sizes for the feeders and mains if the lines be divided into three equal sections and an average drop of 50 volts be allowed.

4. Describe the test for the insulation resistance of the conductors on an electric light line, illustrating the test by an example.

5. A single-phase alternator is required to generate 1000 volts at 60 cycles per second. If the speed is to be 200 R. P. M., how many pole-pieces are required, and what will be the flux from each, the winding being concentrated and consisting of 20 turns at each pole?

6. Describe the single-phase induction motor and explain the process of starting it by the use of the phase-splitter.

7. Describe the methods of locating open circuits and grounds on a long telegraph line.

8. Sketch a duplex telegraph line, naming the parts and giving a general explanation of its action.

EXAMINATION IN CHEMISTRY.

FOURTH YEAR CLASS—MAY 15, 1905.

1. Give the tests for mercury (both forms), ammonium, barium, sulphates, and bromides.

2. Outline the treatment of an insoluble substance when preparing it for analysis.

3. Complete the following equations:

$BaCl_2 + (NH_4)_2CO_3 =$ $3\,CoS + 6\,HCL + 2\,HNO_3 =$

$2FeSO_4 + 4\,NH_4\,HO + H_2\,O_2 =$ $SnCl_2 + 2\,HgCl_2 =$

$Ca\,(C_2\,H_3\,O_2)_2 + (NH_4)_2\,C_2\,O_4 =$

4. Calculate the number of cubic centimeters of sulphuric acid required for a normal solution, the acid used being 97 per cent. pure, sp. gr. 1.84.

5. Name the precautions to be observed in the various stages of a gravimetric analysis.

6. Describe the analysis of steel for per cent. of phosphorus.

7. Sketch the apparatus used for the analysis of steel for carbon, naming the contents of each part of the train.

8. What per cent. of iron is indicated in an ore which, to oxidize the iron in 10 grams of the sample, requires 400 c. c. of a standard solution of potassium permanganate, containing 2.82 grams to the liter?

LITERATURE.

THIRD YEAR CLASS.

Paper Set in February, 1904.

I.—What is the source of the story of "Macbeth," and what changes did Shakespeare make in dramatizing it?

II.—Tell in detail how Lady Macbeth overcame Macbeth's scruples against murdering Duncan.

III.—Trace Macduff throughout the play.

IV.—Why does Macbeth conceal from Lady Macbeth his intention to murder Banquo?

V.—What is the dramatic significance of the first words spoken by Macbeth in the play? What is the dramatic purpose of the conversation between Lady Macduff and her son?

VI.—Define the following terms, illustrating your definitions by referring to incidents, situations, or circumstances in the play: Complicating Circumstances; Resolving Circumstances; Climax; Catastrophe.

VII.—Explain, by comment or paraphrase, the following passages:

(a) "There's no art
To find the mind's construction in the face."

(b) "Or memorize another Golgotha."

(c) "The near in blood, the nearer bloody."

(d) "To all and him we thirst, and all to all."

(e) "Ere to black Hecate's summons,
The shard-borne beetle with his drowsy hums
Hath rung night's yawning peal . . . ."

VIII.—Account for the fact that our greatest dramas were written in the Elizabethan Age.

IX.—Discuss, in a theme of not less than 300 words, one or more of the general characteristics of Shakespeare's plays.

Paper Set in June, 1904.

I.—Compare L'Allegro and Il Penseroso as companion poems, showing in some detail the correspondence in structure and the difference in subject-matter and mood.

II.—

"Or whether thou, to our moist vows denied,
Sleep'st by the fable of Bellerus old,
Where the great Vision of the guarded Mount
Looks toward Namancos and Bayona's hold."

Locate this quotation and explain the allusions.

III.—Discuss the difference between the Mask and the Drama.

IV.—Explain or comment upon the meaning of the following words or phrases:

(a) *Once more,* in "Yet once more, O ye laurels———;" (b) buxom; (c) Friar's lantern; (d) weeds of peace; (e) massy proof; (f) curfew; (g) storied windows richly dight; (h) ruth; (i) darkest grain.

V.—Answer (a) or (b): (a) Account for the fact that Burke never attained a Cabinet position. (b) Outline the "Statement of Facts" in the "Conciliation."

VI.—In the early part of the speech, what reasons does Burke allege against the employment of force? Had he chosen to place these reasons elsewhere, what would have been the proper place for them? Why?

VII.—Compare, as literary periods, the first forty years of the eighteenth century and the first forty years of the nineteenth.

SPECIMEN ENTRANCE EXAMINATION PAPERS

Set for Pupils Other Than Those Entering from the Grammar Schools.

SPELLING AND PENMANSHIP.

Writing from dictation a paragraph or two of some standard text—Irving's Rip Van Winkle or Bancroft's United States History.

GRAMMAR.

I.—Use each part of speech in a different sentence, indicating the part of speech used in each sentence by underscoring and naming it.

II.—Define and give an example of a simple sentence, of a complex sentence, and of a compound sentence.

III.—Parse the underscored words in the following sentence:

"By not heeding the counsels of our elders, how often do we lose what we should gain."

IV.—Analyze the following sentence:

"If we send the sailors a message in time, they will help us when the savages attack us."

V.—Write sentences illustrating the correct use of any perfect tense of each of the following verbs: sit, set, seat, lie, lay, write, go.

COMPOSITION.

The subject set is a description of some well-known place or object, or an account of some historical event.

UNITED STATES HISTORY.

I.—What country was each of the following explorers serving when he came to America, and what territory did he discover or explore: Columbus, De Soto, Drake, Cartier.

II.—Name the principal causes and the principal results of the French and Indian War.

III.—State several causes of the Revolutionary War.

IV.—What were the "Articles of Confederation," and why, and by what, were they superseded?

V.—What is meant by "The Missouri Compromise?"

VI.—Give a short account of the "Nullification" incident.

VII.—What was the most important result of the Mexican War?

VIII.—Name the principal causes of the Civil War. Who commanded on each side at Gettysburg? Why was the battle of Gettysburg so important?

IX.—What reason did the United States assign for going to war with Spain in 1898? What territory did the United States acquire as a result of that war?

ARITHMETIC.

1. An alloy is composed of 3 ½ parts of copper and 2 ⅓ parts of zinc; what is the percentage of each metal in this alloy?

2. Find the proceeds of a note for $625.32 due in 60 days, at 5% interest, dated August 1, 1904, and discounted at bank September 21, 1904, at 6%.

3. Find the cost of paving with brick, 8 inches by 4 inches, a walk 3 feet wide around a rectangular court 20 feet by 18 yards, if the brick cost $12.37½ per M.

4. A firm sold an engine for $7,050, thereby losing 6%; for what should it have been sold to gain 12%?

5. A 50-foot ladder is placed 10 feet from the base of a wall. At what height will its top touch the wall?

ALGEBRA.

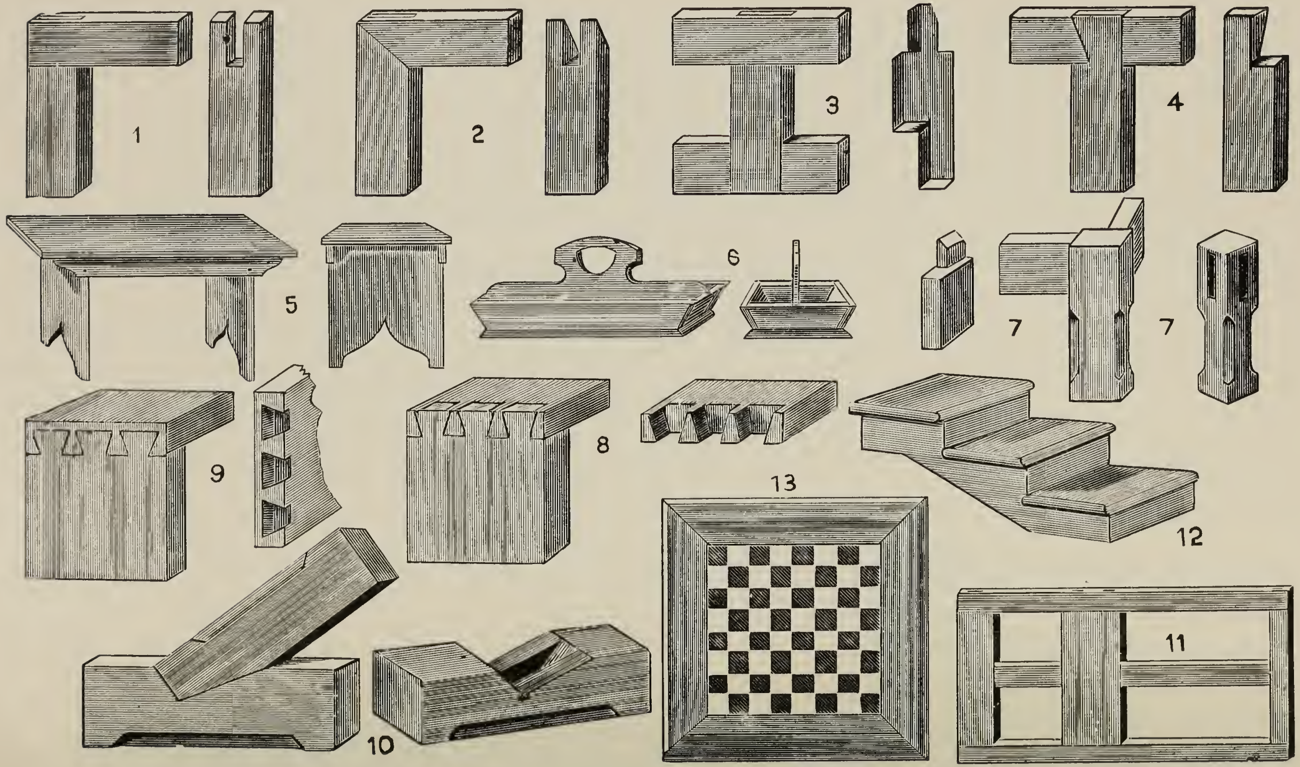
1. Find the L. C. M. of x^2-4a^2, $x^3-3x^2a+2xa^2$, and x^3+8a^3.

2. Simplify $\left[(a^2-x^2)\div\left(\frac{1}{x}-\frac{1}{a}\right)\right]-\left[(a^2-x^2)\div\left(\frac{1}{x}+\frac{1}{a}\right)\right]$

3. Given $\frac{2x+1}{5}-\frac{3y+2}{7}=2y-x$, $\frac{3x-1}{4}+\frac{7y+2}{6}=2x-y$, find the values of x and y.

4. The circumference of the hind wheel of a carriage exceeds that of the front wheel by 4 feet. If the front wheel makes the same number of revolutions in running 400 yards that the hind wheel makes in running 500 yards, what is the diameter of each wheel?

5. Solve the equation $\frac{5x-1}{x+3}+\frac{7x^2-106}{8(x^2-9)}=-\frac{1}{8}$



CARPENTRY.

CATALOGUE OF STUDENTS.

(Corrected to December 31, 1905.)

Students whose names are marked with an asterisk received 85% or more of the possible multiple for the year.

FOURTH YEAR—A CLASS—57 MEMBERS.

(Corrected to December 15, 1905.)

H. Roy Anderson,
Moses Appel,
Theodore H. Ascherfeld,
Walter K. Bachrach,
*Harry C. Becker,
Isadore Behrman,
*J. Ralph Bolgiano,
William Wallace Boyd,
Charles A. Butzler,
G. Herman Carl,
*Willis B. Clemmitt,
*Charles H. Dorsey,
George Erck,
*Harry C. Finck,
*Edwin Friese,
Otto A. Geumann,
Edwin B. Gilmour,
*John R. Guttmann,
*John R. Haswell,
*E. Kenneth Hebden,
Charles W. Henderson,
Robert Q. Herring,
Harry Lee Hess,
George F. Heubeck,
*Ralph Holbrook,
Andrew C. Kemler,
Howard G. Lanahan,
George F. Lehmann,
*Frank T. Leilich,
*Harold M. Lewis,
Bernard A. McAbee,
J. Kilby McGrath,
George F. Maynard,
*Carl F. Meyer,
Lawrence G. Miller,
Sidney D. Mitchell,
Harry Murray,
*Ferdinand Oppenheimer,
*John G. Pertsch, Jr.,
*Lewis W. Porter,
Charles J. Rasch,
*John T. Ridgely,
Arthur S. Scharnagl,
*John C. Schirmer,
Edward K. Stembridge,
David B. Stewart, Jr.,
*Levin H. Stewart,
Israel E. Stolberg,
Frank T. Suman,
Nicholas C. Thalheimer,
T. Leonard Walter,
Raymond M. Weaver,
*George F. Wennagel,
*George F. Wieghardt,
Philip H. Williamson,
*Walter B. Wills,
R. Horatio Wright.

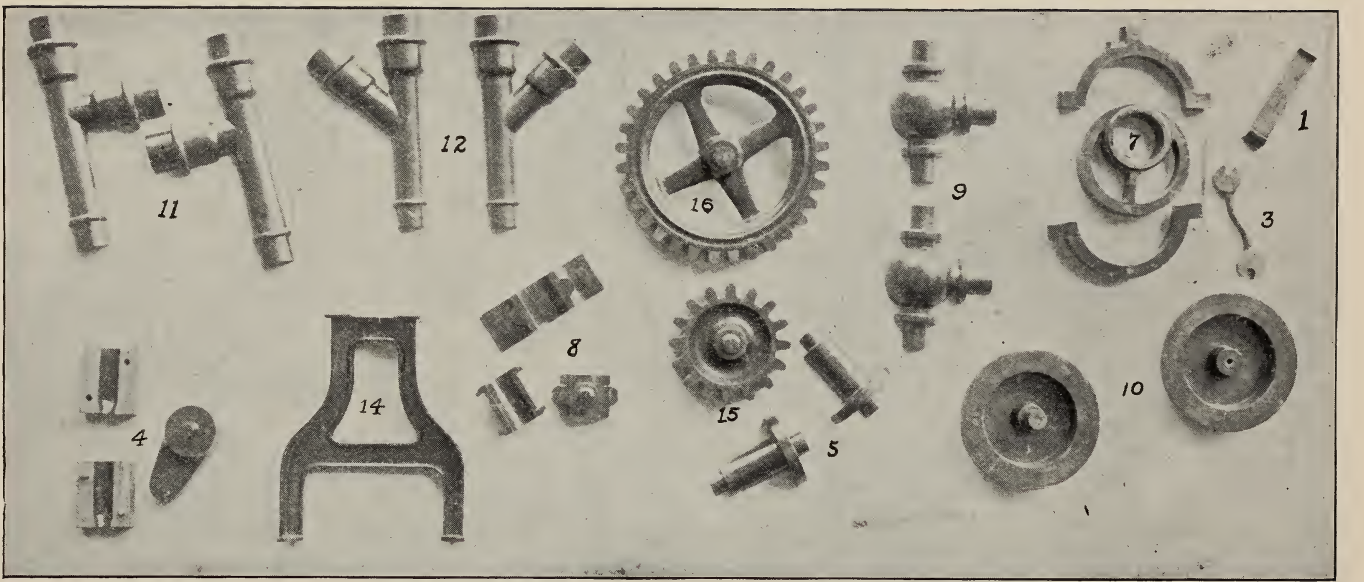
THIRD YEAR—B CLASS—60 MEMBERS.

(Corrected to December 15, 1905.)

Ludwig Aull,
Emil G. Bauerfeld,
Raymond M. Bealer,
*Alvin M. Bland,
Gustav Bornscheuer,
*J. Daniel Brendel,
*John N. Childs,
Joseph W. Cushing,
Wilmer A. Dehuff,
C. Lehman Downs,
Howard A. Essig,
*Herbert S. Fairbank,
*F. Donald Fenhagen,
Charles E. Grimes,
*Henry R. Gundlach,
*G. Herman Guttmann,
*Carroll R. Harding,
William Hartman,
George G. Hayden,
Horace K. Hayden,
Guy L. Hess,
*F. Merrill Hildebrandt,
Fernando Janer,
Harry B. Joyce,
Laurence A. Kahn,
John P. Kenney,
M. Rock Kiefer,
Charles Krausse,
William H. Krueger, Jr.,
George M. Lawrence,
Frank H. McCormick,
William G. McLaughlin,
Laurence F. Magness,
Joseph C. Manning,
August Mencken,
Richard C. Meyer,
*Charles E. Mitchell,
Serafin M. Montesinos,
George T. Mumma,
Marcus Newhoff,
Samuel P. Nixdorf,
Arthur Norden,
Edwin H. Nordmann,
Robert B. Pumphrey,
*Charles J. Ritterhoff,
Ernest Rodemeyer,
George S. Schlutter,
Arthur H. Schultz, Jr.,
Nelson Schuster,
Emil Sedlacek,
Harry Siegel,
*Frederick B. T. Siems,
V. Bernard Siems,
Charles Silver,
Samuel F. Tapman, Jr.,
Carroll E. Tauszky,
*Franklin L. S. Walter,
*Bernard Wich,
R. Mason Wilhelm,
*Julius Zieget.

SECOND YEAR—C CLASS—129 MEMBERS.

Otto E. Adams,
*Gelston H. Armstrong,
Howard V. Bell,
*Cullum S. Benson,
Harry L. Black,
Clarence P. Bolgiano,
Gilbert F. Bolgiano,
Arthur W. Bordley,
Clarence Boyd,
Joseph L. Bozman,
Wilbur L. Brooks,
Emmett B. Bryan,
Charles H. Buck, Jr.,
Joseph D. Bullock,
James H. Busick,
Maurice C. Butler,



PATTERN WORK.

*Nathan R. Butler, Jr.,
*Walter S. Byrne,
*James R. Carroll, Jr.,
George J. Cherry,
William G. Coffin, Jr.,
Robert C. Cole,
*Thomas D. Conn,
*Josias M. Creamer,
Percy Davenport,
*Franklin Davis,
Arturo Diaz,
Raymond G. Ehrman,
*William H. Eichner,
George Frey,
*Austen Gailey,
Horatio N. Gambrill, Jr.,
MacDonald Garrettson,
James T. Garrity,
George S. Giles,
Harry P. Godman,
Frank Goldenberg,
Eugene Graham,
James R. Green,
*Thomas M. Green,
T. Douglas Gresham,
Herbert Griffin,
Robert M. Hall,
Walter L. Heathcote,
Fred. H. N. Heemann,
Bertram E. Heinz,
*Walter F. Heise,
Edward B. Herrmann,
Harry C. Hess,
Harry W. Hill,
*Milton A. Hodes,
*Abraham A. Hollander,
*Henry J. Horn,
*Raymond H. Hoskins,
William A. Hubbard,
Charles W. Huegelmeyer,
*Henry Arad Israel,
Wilbur Jackson,
Manuel Janer,
*Henry Janney,
Irving Johnson,
George R. Johnston,
Charles R. Justi,
Charles F. Kaesemeyer,
Thomas M. Kenny,
Ernest F. Knabe,
*Lawrence R. Laroque,
Fayette M. Latham,
*Walter R. Lee,
Andrew H. Lemmon,
Frederick W. Lieberknecht,
Thomas M. Linthicum,
George H. McClelland,
Louis McLanahan,
Samuel E. McQueen,
Thomas N. Manning,
Edgar Markel,
Thomas Mayer, Jr.,
Thomas B. Meushaw,
Howard E. Mitchell,
Bernard Munter, Jr.,
Clarence Nagle,
Edwin W. Nelson,
Robert E. Palle,
Walter F. Perkins,
Allen H. Potts,
*Mitchell Price,
Frederick L. Purdy,
Edward Rasmers,
James P. Ray,
*Frank Reed,
Norman G. Reinicker,
*Herbert B. Reynolds,
Norman F. Rigor,
Edwin Rolker,
Charles D. Sapp,
Gustav W. Schindhelm,
*Raymond Schlegel,
*Christian Schluderberg,
*Othello H. Schroedl,
Alexander P. Schumann,
*Arthur G. Schuster,

Louis C. Schwartz,
Anthony Sedlacek,
David W. Shilling,
John L. Shipley,
Frank E. Shorey,
Harry M. Siegle,
Otto Sima,
Carlos A. Soler,
Benjamin F. Starr,
*Milton D. Swartz,
William F. Tapking, Jr.,
Fraser G. Thatcher,
Murrill M. Thomas,
Francis J. Thomsen, Jr.,
William J. Tjarks,
*Walter M. Troll,
Carl Virgin, Jr.,
Henry Vogt,
Romaine G. Waltenberg,
*Carl C. S. Walter,
Frank T. Weaver,
Charles R. Webber,
Edgar F. Wiencke,
Craig McM. Wills,
Charles E. Woollen,
*Martin Wright,
*Frederick A. Zscheuschler,

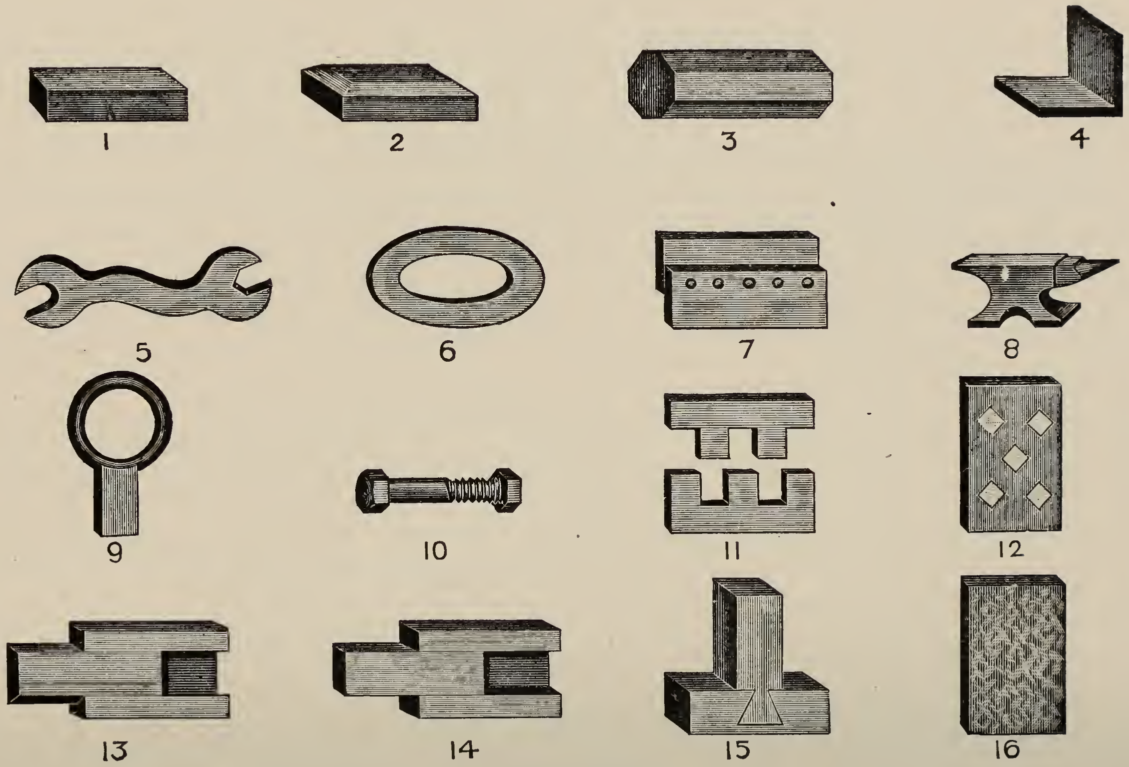
FIRST YEAR—D CLASS—246 MEMBERS.

Joseph Aaron,
Frederick B. Abbott,
Oakland F. Adams,
Edgar Allison,
Joseph L. Arthur,
Earl C. Ascherfeld,
Harry C. Baker, Jr.,
Louis Barron,
Murrell R. Beard,
Clarence F. Becker,
Harry C. Becker,
Frank Beehler,
John A. Bennett,
J. Campbell Bennett,
Ralph G. Bittle,
Barry Black,
Morris Block,
Oscar M. Block,
John G. Bobb,
Bernard R. Bockelman,
George Boeckel,
Clarence G. Boggs,
Ralph C. Bolgiano,
George C. Borst,
Ralph G. Braun,
Harry M. Bremer,
John Howard Brown,
J. Edgar Bryan,
J. Ellsworth Buck,
William Buechler,
Frederick Burggraf,
William H. C. Burke,
Harry U. Butler, Jr.,
Edward E. Calder, Jr.,
Carlton DeV. Cann,
Arnold W. Carnan,
Ralph W. Cathell,
George A. Chase,
Leo J. Clancy,
Henry C. Clark,
Augustus P. Clarson,
Charles S. Cole, Jr.,
Oliver Conradi,
Douglas Corner,
Louis Cremona,
Harry W. Crist,
William N. Crist,
James A. Crutchfield,
William D. Dalrymple,
John S. Delano,
Lewis A. Deliz,
Horatio Demarest, Jr.,

Edgar O. Doeplitz,
Roger B. Drenning,
Howard T. Dyott,
Auville Eager,
Bowie G. Etchison,
Frank Fahm, Jr.,
Raymond G. Firoved,
Clarence J. Flayhart,
Roy D. Fleckenstein,
Emil G. Forthuber, Jr.,
George Fultz,
G. Morrison Gaither, Jr.,
Wilson N. Gambrill,
Rafael Garcia,
Charles R. Geisz,
George E. Gerlach,
Harry G. Gill,
F. C. Latrobe Gilley,
John Glaeser, Jr.,
Irvin B. Gorman,
Arthur H. Green,
George E. Green,
Frederick C. Hall,
William T. Hanzsche, Jr.,
James N. Heile,
William Heise, Jr.,
Lester P. Henderson,
Frank P. Herrmann, Jr.,
Gustav A. Herth,
Elmer Heubeck,
William J. K. Hewitt,
Walter E. Higham,
Charles H. Hillegeist,
James R. E. Hiltz,
William V. Hipsley,
Stanley Hoen,
Louis P. Hofferbert,
Joseph A. Hohman,
Franklin E. Holland,
Gurdon K. Hoopes,
Robert Jackson,
Adam W. Jahn,
Arthur W. Janushek,
Levin W. Jenkins,
Arthur Johnstone,
Morris G. Jory,
Albert Karl,
John M. Keck,
Josiah L. Keck,
Edward M. Kennard, Jr.,
Philip P. Kesler,
Robert W. Keyes,
Bernard G. Keys,
Harry J. Kiefer,
William B. King,
Robert C. Knipp,
Emil J. Koch,
John L. Krausz,
Henry E. Kries,
Gibbs LaMotte,
Louis E. Lamborn,
William D. Lamdin,
George K. Landon,
Edward H. Lange,
Harrison W. Langrall,
Henry S. B. Latham,
Mariner Lawrence,
Vernon H. Leitch,
George Lentz,
Elmer A. C. Lenz.
George D. Leonard,
Joseph H. Letzer,
Joseph H. Lewis,
John P. Link, Jr.,
Emil J. Little, Jr.,
Frederick W. Lockwood,
George B. Lohmuller,
Harry London,
James Lorden,
James T. McCarthy,
J. Alexander McDermott,
William J. McGahan,
Harrison H. McPherson,
Clifton W. Maccubbin,
Charles F. Martin,
Joaquin Martinez,

William J. Mason,
Roger B. Maxwell,
Ridgaway R. Merryman,
Henry C. A. W. Meyer,
Howard O. Michael,
Joseph R. Michel,
William R. Milburn,
Harry V. Miller,
Julius O. Mirski,
Harold M. Moat,
Charles H. Mohr, Jr.,
John E. Moran,
Richard V. Mossop,
Alfred Mullikin,
Alexander J. Munro,
Alexander Myers,
Ammon F. Neiswender,
Arthur B. Nickerson,
Emory H. Niles,
Alfred Nisbet,
John M. Nuetzel, Jr..
Charles F. O'Donnell,
Andrew G. O'Rourke,
Charles H. Orf,
Walter J. Padgett,
Morris C. Pawley,
Edgar A. Pfeil,
Milford L. Pitcher,
Orlando B. Platt,
William D. Platt, Jr.,
James R. Plitt,
Vincent Prenger,
Stephen W. Price,
James B. Pryor,
Conrad H. Pund,
Roland W. Quandt,
Clarence W. Ragland,
Herbert C. Randall,
Howard R. Reese,
Ramsay G. Regester,
Lee B. Rever,
Raymond R. Rever;
Arthur S. Richmond,
Mark Rigor, Jr.,
Charles E. Roberts,
John J. Rodemeyer,
Frederick W. Roerentrop, Jr.,
Paul Rosenthal,
Clarence D. Russell,
Clarence M. Sadtler,
Herbert Sadtler,
Albert H. Samuel,
William S. Saunders,
Philip Schad,
William H. E. Schaefer,
Lewis N. Scherf,
Conrad R. Schneider,
William H. Schneider,
John E. Schorr,
Carl K. Schulte,
George W. Schweitzer,
Walter R. Sewell,
Ernest Shema,
Harry B. Siegmund,
John L. Siems,
William H. J. Siems,
Charles Sima,
John Snyder,
Ernest Southerington,
Morris A. Spamer,
George C. Spillner,
Frederick C. Stauffen,
Samuel P. Stewart, Jr.,
Edward C. Storch,
Lawrence C. Stoudenmire,
Milton C. W. Strobel,
George J. Sturmfelsz,
Robert V. O. Swartwout,
John C. Taylor,
Herbert M. Thomas,
Murrell M. Thomas,
Leroy K. Thompson,
Raymond W. Thompson,
Henry B. Tinges,
Samuel R. Tinkler,
Robert G. Tippett,

Horace C. Turner,
Robert B. Turner,
Nathan Ullman,
George W. Van Daniker,
Wilbur N. Van Sant,
Cornelius Vernon,
Wilmer W. Wagner,
Philip E. Waldschmidt,
James R. Walker,
John F. Wannenwetsch,
Herbert L. Weaver,
Albert E. Welch,
Russell D. Welsh,
Herman A. Wieghardt,
Ralph S. Williams,
Richard H. Williams, Jr.,
William D. Wilson,
Bertram S. Winchester,
Donald B. Wood,
William L. Wuestner,
John E. Yewell,
Charles A. Yockel,
Arthur Ziegler.



VISE WORK.

CLASS ORGANIZATIONS.

CLASS OF '06.

President	Sidney D. Mitchell.
Vice-President	Edward K. Stembridge.
Secretary	David B. Stewart, Jr.
Treasurer	George F. Wieghardt.

CLASS OF '07.

President	Guy L. Hess.
Vice-President	Herbert S. Fairbank.
Secretary	Julius Zieget.
Treasurer	Bernard Wich.

CLASS OF '08.

President	Samuel E. McQueen.
Vice-President	————
Secretary	Othello H. Schroedl.
Treasurer	Walter F. Heise.

CLASS OF '09

President	Robert V. Swartwout.
Vice-President	Clinton G. Boggs.
Secretary	George A. Chase.
Treasurer	Samuel R. Tinkler.

LITERARY SOCIETIES.

THE "LOWELL."

President	Raymond M. Weaver, '06.
Vice-President	Sidney D. Mitchell, '06.
Secretary	John G. Pertsch, '06.
Treasurer	Thomas M. Green, '08.
Sergeant-at-Arms	John R. Haswell, '06.
Reporter	Charles J. Rasch, '06.
Executive Committee	W. Mitchell Price, '08. Charles J. Rasch, '06. The President, *ex-officio.*

THE "POE."

President	Julius Zieget, '07.
Vice-President	Herbert S. Fairbank, '07.
Secretary	J. Daniel Brendel, '07.
Treasurer	Harry B. Joyce, '07.
Reporter	Allen H. Potts, '08.
Executive Committee	Wilmer A. Dehuff, '07. Frank Reed, '08. The President, *ex-officio.*

The literary societies meet weekly on Friday afternoons. In a public contest in debate held at the Western High School on April 28, 1905, the "POE" was unanimously awarded the decision over the "CARROLLTON-WIGHT" Literary Association of the Baltimore City College; and the "Lowell" and the "Poe" gave, in the same hall, on June 23, 1905, a dramatic entertainment consisting principally of the "Pyramus and Thisbe" scenes from the "Midsummer Night's Dream."

ATHLETICS.

ATHLETIC ASSOCIATION.

President	C. E. Mitchell, '07.
Vice-President	Guy L. Hess, '07.
Secretary	W. D. Platt, Jr., '09.
Treasurer	Herman Carl, '06.

ATHLETIC BOARD.

Herman Carl, '06
Willis B. Clemmitt, '06.
Charles W. Henderson, '06.
Guy L. Hess, '07.
F. H. McCormick, '07.
C. E. Mitchell, '07.
E. B. Bryan, '08.
W. J. Tjarks, '08.
E. F. Wiencke, '08.
R. G. Firoved, '09.
G. LaMotte, '09.
W. D. Platt, Jr., '09.

William L. DeBaufre, from the Faculty.
Charles R. Gantz, from the Alumni.

FOOTBALL.

The football season of 1905, while not prolific in victories as shown by the scores, was yet eminently successful in that the experience and training gained in lining up against heavier teams in the early part of the season enabled the team to come nearer than ever before to their ultimate goal in the final game of the year. The line-up of the team was:

Clemmitt	Left End.
Carl	Left Tackle.
Heubeck (Hebden)	Left Guard.
Virgin	Centre.
Benson (Lanahan)	Right Guard.
Mitchell	Right Tackle.
Bryan	Right End.
Tauszky (Captain)	Quarter Back.
Aull (Hess)	Right Half Back.
Swartwout (Thomsen)	Left Half Back.
Henderson	Full Back.

Substitutes—Latham, Haswell, McCormick, Herring and Miller.

The following is a summary of the games played:

Oct. 7, at College Park: Polytechnic, 0; Md. Agricultural College, 20.
Oct. 14, at Port Deposit: Polytechnic, 0; Tome Institute, 11.
Oct. 28, at Ellicott City: Polytechnic, 6; Rock Hill College, 6.
Nov. 4, at Druid Hill Park: Polytechnic, 5; Ruxford Athletic Club, 0.
Nov. 8, at Walbrook: Polytechnic, 0; Boys' Latin School, 6.
Nov. 11, at Chestertown: Polytechnic, 0; Washington College, 2d, 11.
Nov. 15, at Clifton Park: Polytechnic, 0; Loyola College, 0.
Nov. 17, at Country School: Polytechnic, 5; Country School, 11.
Nov. 30, at Annapolis: Polytechnic, 0; Naval Academy Plebes, 16.
Dec. 9, at Maryland Oval: Polytechnic, 4; Baltimore City College, 6.

The official "P" was awarded to the following in football:

Clemmitt, Carl, Heubeck, Virgin, Benson, Mitchell, Bryan, Tauszky, Aull, Swartwout, Henderson, Lanahan, Hess, Hebden and Thomsen.

The secondary honor, "P. A. A.," was awarded to the following:

Latham, Haswell, McCormick, Herring and Miller.

THE POLYTECHNIC ORCHESTRA.

Franklin Walter, '07, *Director*	First Violin.
Frederick Roerentrop, '09	First Violin.
William Eichner, '08	Second Violin.
Julius Ziegет, '07	Viola.
Louis Schwartz, '08	Cello.
Serafin Montesinos, '07	Clarinet.
Fernando Janer, '07	Flute.
Walter Heise, '08	Cornet.
C. Cecil S. Walter, '08	Piano.

THE MANDOLIN CLUB.

Manager	Sidney D. Mitchell, '06.
Director	Isadore Behrman, '06.
Secretary	Foster Maynard, '06.
Treasurer	Horatio Wright, '06.
Pianist	Sidney D. Mitchell, '06.
Assistant Pianist	Henry Gundlach, '07.
Violin	Isadore Behrman, '06.

First Mandolins:

Serafin Montesinos, '07.
Fernando Janer, '07.
Ralph Bolgiano, '06.
Alfred Mulliken, '09.
Robert Herring, '06.

Second Mandolins:

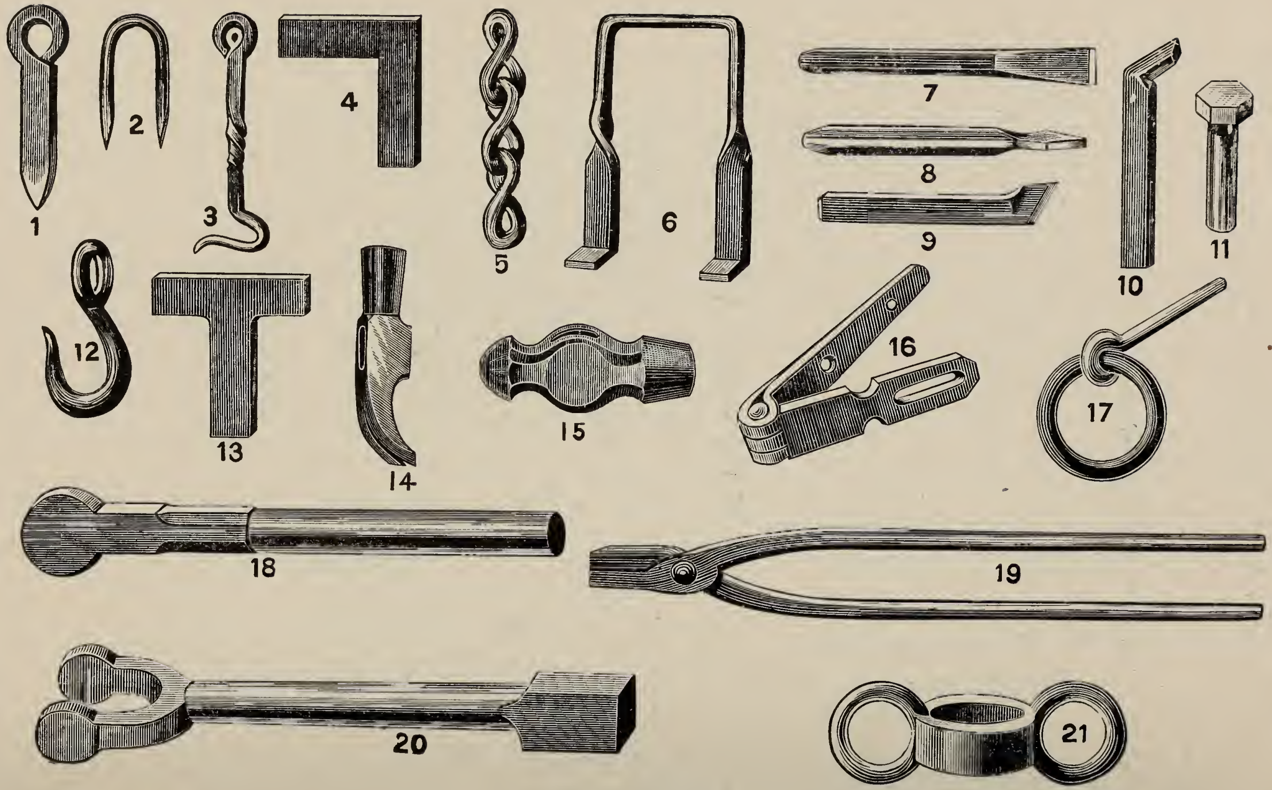
Foster Maynard, '06.
L. Stoudenmire, '09.

Guitars:

Daniel Brendel, '07.
Charles Henderson, '06.
Horatio Wright, '06.
Henry Israel, '08.
George Heubeck, '06.

Banjos:

Carlos Soler, '08.
John Childs, '07.



FORGE WORK.

CATALOGUE OF GRADUATES.

CLASS OF '87.

Clarence G. Bouis,
George C. Bump,
Lucien Dallam,
Otto H. Ehlers,
Osma K. Gardner,
Herbert F. Gorgas,
Joseph Greenbaum,
Henry W. Hahn,
Minor F. Heiskell,
Robert Hooper,
William S. Hugg,
Thomas J. Irons,
Joseph H. Kuehn,
P. Charles Nelson,
Flavius J. Pennington,
Richard Piez,
Henry M. Price,
Walter G. Reinicker,
William A. Robertson,
Albert Rosenberg,
James B. Scott,
Walter R. Sweeney,
James C. Thompson,
Adolphus Tiemeyer,
Frederick H. Wagner.

CLASS OF '88.

Arthur O. Babendrier,
Edward Binswanger,
Bernard H. Brooke,
Sydney S. Bouis,
Julius Fireman,
Thomas G. Ford,
George M. Gaither,
John H. Harvey,
Howard Harvey,
Walter J. Herrman,
Joseph H. Hooper,
John P. Jefferson,
William Johnston, Jr.,
William Mencke,
William F. Mylander,
Edwin F. Orem,
Edward B. Passano,
George E. Repp,
Harry E. Roberts,
George C. Robinson,
Hanson Robinson,
Robert E. Rodgers,
George H. Sickel,
Washington B. Stanton,
Orlando C. Weeks.

CLASS OF '89.

William F. Ackerman,
Samuel R. Adams,
Morgan H. Baldwin,
Isaac Behrend,
Louis H. Gerding,
Arthur Gordon,
Ernest Griffith,
John S. Hand,

Joseph Isaac,
Claiborne M. James,
Albert C. Layman,
Charles W. Leach,
J. W. C. Meikle,
Rozier L. Bouis,
Robert H. Buschman,
Charles C. Constantine,
Albert T. Barrett,
John L. Ehrman,
Allyn Field,
Harry M. Ford,
Edward P. Cromwell,
Howard Crosby,
George W. Moog,
John K. Mount,
Robert W. Peach,
Charles E. Phelps, Jr.,
William G. Robertson,
Robert C. Round,
Myron S. Rose,
William C. Seigmund,
Joseph Steifel,
Harry P. Suman,
Carroll Thomas.

CLASS OF '90.

John F. Abendschein,
G. S. Barnes,
J. H. Bokee,
W. H. Broadbelt,
W. H. Fahrinholt,
Chris. Feick,
J. Froelich,
William P. Gundry,
E. C. Harris,
J. C. Mattoon,
John D. Pugh,
A. O. Robertson,
William F. Schultz,
Michael D. Schaefer,
William P. Shriver,
Theodore Straus,

CLASS OF '91.

Walter Amos,
Basil Benson,
William Benson,
William Boucsein,
Morde Bren,
John J. Caine,
George Dannettel,
Charles Ehlers,
Ferdinand B. Keidel,
J. Edgar Knipp,
Samuel McNeal,
James C. Phillips,
Herbert M. Reese,
Edmund W. Robinson,
Reuben Row,
Warren S. Seipp,
Richard S. Warner,
William A. Young.

CLASS OF '92.

Edwin W. Antes,
John P. Baer,
Frank J. Borie,
B. Harrison Branch,
Leonard Burbank,
William C. Butler, Jr.,
Frank B. Hooper,
Edgar N. King,
John Langford,
Louis Liepman,
R. M. Miller,
J. W. Dawson, Jr.,

Royal R. Duncan,
Charles R. Durling,
Isidor Deutsche,
Walter H. Eisenbrandt,
William T. Holmes,
J. C. Miller,
Joseph Mullen,
William H. Rose,
Albert G. Singewald,
William H. Soine,
William E. Straus.

CLASS OF '93.

Theodore H. Ackerman,
Herbert Addison,
Oregon R. Benson,
Percy Thayer Blogg,
C. Raymond Carson,
William John Cochran,
E. C. D'Yarmett,
Henry M. Fitzhugh,
Clarence S. Hand,
James F. McShane,
Clarence F. Morfit,
F. H. Phelps,
Edwin Schenck,
John R. Uhler,
L. Ismay Van Horn,
Charles P. Weishampel,
R. L. Williams.

CLASS OF '94.

Edward H. Bell,
Albert E. Bowen,
J. Straith Briscoe,
Harry Cotton,
Carroll Edgar,
Frederick Kopp,
Philip Littig, Jr.,
Thomas Q. McGinn,
Herbert A. McGaw,
Horace J. Miller,
Louis Mueller,
George M. Parlett,
Charles Schlicker,
Alan P. Wilson,
John Zeubert,
Pliny Cutler Hall,
Edward J. Herring.

CLASS OF '95.

George W. Brown,
Clifton A. Coggins,
Harry W. Francis,
Graham B. Hall,
William W. Hogendorp,
Albert J. Hooper,
Frank A. Hornig,
Howard L. Hoskins,
Edward M. Likes,
Ward P. Littig,
Alfred F. Loeser,
Thomas J. H. Magness,
Herman F. Meyer,
George N. Rogers,
Hamilton D. Ruth,
Richard F. Weishampel,
Carl A. Witthaus.

CLASS OF '96.

Samuel Hosea Armstrong,
Howard Douglas Bennett,
James Gomelia Boss, Jr.,
William Augustine Boykin, Jr.,
Robert Lemmon Burwell,
Harry Parr Diggs,
Frederick L. H. Glendmeyer,
William Howard Hamilton,
Arthur Worthington Hawks, Jr.,
Frederick Worthington von Stein,
Louis Kemp Hennighausen,
Harry Louis Homer,
Ludford Cohoon Jones,
Leon Alvyn Kohn,
Erich Albert Loeser,
Henry Louis Mencken,
Harold Vincent Patterson,
Harry Clay Powell, Jr.,
Gilmor Meredith Ross,
Thomas Quincy Scott,
Henry Bonn Silverthorn,
William Henry Smith,
Roscoe Conkling Sweeny,
Charles Edwin Wilson,
Olin Alexander Wilson.

CLASS OF '97.

Louis Fabian Bachrach,
Alan Marion Bennett,
William Melvin Carter,
Elvin Griswold Cromwell,
John Towson Elsroad, Jr.,
John Montgomery Gambrill,
Ernest Cummins Hatch,
William Hain Kirwin,
Harry L. Kugler,
Chester Waters Larner,
Howard Osgood Preston,
George Gottlieb Schnepfe,
Frederick Lewis Schwartz,
Joseph Stewart Smith, Jr.,
Douglas Alan Sparks,
Joseph Morrison Sparks,
Wilson Ward.

CLASS OF '98.

Thomas Jefferson Andrews,
Alan Joseph Bachrach,
Leo Bauerfeld,
Wilbur McKnew Bosworth,
Frederick Derick Dollenberg, Jr.,
Romulus Griffith Doyle,
John Howard Flayhart,
Henry Galloway,
Charles Raymond Gantz,
Samuel Thomas Griffith,
Alfred Cummins Hatch,
William Herman Hubers, Jr.,
Joseph Lowrie Ingle, Jr.,
John Scott Longnecker,
John Walter McGreevy,
Edward Harris Mealy,
William Charles Metcalf,
John Floyd Miller,
William Eldred Nolan,
Gurdon Tyler, Pollard,
Walter Percy Poole,
John Maurice Rehberger,
John McCullough Rife,
Harry Rufus Ruse,
Paul Edward Schaun,
John Henry Sirich, Jr..,
John Smith,
Herbert Turner Snyder,
George Creamer Wilcox.

CLASS OF ’99.

Charles E. Allen,
William B. Boettinger,
Harrison Brent,
Hugh W. Brent,
Edward Goodnow Clayton,
Edward P. Cooke,
Charles C. Crokett,
William W. Cushing,
Arthur Councilman Davis,
Charles H. Demitz,
Roland S. Focke,
Harry B. French,
Robert B. Harper,
Charles W. Held,
Ira Johnson,
George A. Knapp,
Walter B. Lang,
Harry Lowenthal,
George P. McCeney,
William E. McCord,
Marion H. McCoy,
Charles E. Mencken,
Charles T. Owens,
Edw. L. Schaun,
Harold B. Vincent,
Joseph A. Ward,
Charles C. Lucke,
John N. McCleester,
Blakeley A. McDonnell,
Edwin G. O’Conner,
William Taylor Phipps,
Emanuel J. Sedlacek,
Frederick C. J. Sternat,
Joseph R. Walter,
William C. Whelan.

CLASS OF ’00.

John Walter Fred. Blizard,
Roy Stevenson Houck,
Galt Fayette Parsons,
Samuel Moore Johnson,
Luther Chase Wright,
Walter Bowen Buttner,
Gustav Frederick Linck,
Horace Kirk Faust,
Thomas Osborn Wanseben,
Morgan Moore,
John Charles Masopust,
Walter Groverman,
Lawrence Gunton Allbutt.

CLASS OF ’01.

Joseph M. Beehler,
C. Ernest Conway,
William M. Demitz,
Charles F. Goob,
Richard G. Harris,
Irving C. Hess,
Charles W. Hoppert,
Carlisle L. Hubbard,
Edward E. Johnston,
Thomas H. Kenney,
Charles E. Lane,
Andrew J. Lowndes,
Ross E. Lynch,
Allen L. Malone,
Richard E. Marston,
Harry Mehrling,
John A. Raidabaugh,
T. Warden Rinehart,
William B. Rosenthal,
Edward Samuel,
John C. Siegle,
Walter H. Tapman,
Sidney C. Vincent,
George P. von Eiff,
Ernest B. Walton,
Arthur S. Weiss,
George K. Yost,
Philip H. Zipp.

POST-GRADUATE CLASS OF '02.

(Four Year Course.)

Joseph M. Beehler,
C. Ernest Conway,
Irving C. Hess,
Andrew J. Lowndes,
Allen L. Malone,
John A. Raidabaugh,
Sidney C. Vincent,
George P. von Eiff,
Philip H. Zipp.

CLASS OF '02.

Joseph A. Baldwin,
Frank O. Boyd,
John B. Cautley,
Robert Dall,
William L. De Baufre,
John K. Flickenschildt,
Walter M. Gieske,
Donald S. Hays,
Joseph T. Henthorn,
John S. Hess,
I. Seeley Jones,
D. Frank Lamble,
LeRoy M. Langrall,
H. Quimby Layman,
John G. M. Leisenring,
William N. Michael,
Charles A. Pettit,
William S. Samuel,
G. Forney Shryock,
Charles F. Yardley.

POST-GRADUATE CLASS OF '03.

(Four Year Course.)

John B. Cautley,
Robert Dall,
William L. De Baufre,
John K. Flickenschildt,
Walter M. Gieske,
Donald S. Hays,
John S. Hess,
I. Seeley Jones,
LeRoy M. Langrall,
H. Quimby Layman.

Specials { Arthur C. Davis,
Charles A. Pettit.

CLASS OF '03.

Elmer Armiger,
Paul Backhaus,
Oscar F. Benjamin,
Owen C. Blades,
Harry N. Brannan,
Frank B. Burton,
William N. Crisp,
John W. Dorsey, Jr.,
Christopher J. Frank,
Milton H. Gross,
Harold M. Parsons,
Ernest M. Poole,
J. McDonnell Reid,
Martin J. Reynolds,
Edward Hering,
Charles E. Herth,

James B. Jones,
Milton Kraemer,
Herman Lucke, Jr.,
Edmund C. Lynch,
Arthur B. Marston,
Harry M. Mason, Jr.,
Sidney Newhoff,
Manley P. Northam,
August H. Schaaf,
Howard I. Schultz,
George F. W. Sims,
Wilmer T. Stone.

POST-GRADUATE CLASS OF '04.

(Four Year Course.)

Paul W. Backhaus,
Harry N. Brannan,
William N. Crisp,
Edward Hering,
James B. Jones,
Milton Kraemer,
Harry M. Mason, Jr.,
J. McDonnell Reid,
Martin J. Reynolds,
George F. W. Sims,

Specials
Frank B. Burton,
H. Milton Gross,
August H. Schaaf.

CLASS OF '04.

Chester A. A. Albrecht,
James B. Arthur,
Marion V. Bailliere,
Joseph Bowes, Jr.,
Andrew K. Brumbaugh,
Clarence C. Clickner,
Edward C. Cromwell,
Frederick L. Dixon,
Charles A. Edel,
Frank P. Fifer,
Emanuel Fritz,
George Gittelsohn,
J. Lyell Gressitt,
Edward J. Hecker,
John H. Hills,
Harry J. Hodes,
Benjamin F. Hoffacker,
Harry V. D. Hunt,
William C. Hurley,
Charles A. Langrall,
Herman W. Lasser,
Daniel J. Leary,
Leon Marmor,
Samuel May,
John L. Mosher,
Charles P. Niederhauser,
Robert G. Pangborn,
Massimo Pisani, Jr.,
George S. Robertson,
George M. G. Schaefer,
Leon Small,
Oscar E. Smith,
Marion Steinberger,
Harry D. Thurlow,
Harry Waldorf,
Charles W. Whittle,
Edwin L. Wilson,
Louis A. Witte,
William P. Wittmer,
Alexander H. Woollen.

POST-GRADUATE CLASS OF '05.

Chester A. A. Albrecht,
James B. Arthur,
Joseph Bowes, Jr.,
Edward C. Cromwell,
John W. Dorsey, Jr.,
Charles A. Edel,
Frank P. Fifer,
Emanuel Fritz,
J. Lyell Gressitt,
Richard G. Harris,
Edward J. Hecker,
John J. Hills,
Benjamin F. Hoffacker,
Harry V. D. Hunt,
Charles A. Langrall,
Samuel May,
John L. Mosher,
Robert G. Pangborn,
Massimo Pisani, Jr.,
Leon Small,
Marion Steinberger,
*Harry DeG. Thurlow,
Harry Waldorf,
Edwin L. Willson,
Alexander H. Woollen.

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*Deficient in Mechanics; allowed a reëxamination in September and passed.

CLASS MEMORIALS.

Framed Portrait of Dr. Henry A. Rowland. Presented to the Institute by the Fourth Year Class of 1903.

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